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ABSTRACT

The project described was designed to develop prototype electronically controlled learning environments in home settings, in order to provide instruction for persons with assumed severe developmental retardation and attendant multiple handicaps. The first of nine sections in this report contains the justification for the project, abstracted critical components of the request for proposals, and a list of the major objectives proposed for the project. Specific steps and major events are listed in chronological order in Section 2. Sections 3, 4, and 5 report the procedures and outcomes of system development, child referral and family demographic information, and instructional home intervention. Contributed services from the University of Kentucky Center for the Handicapped are described in Section 6, child performance profiles are listed in Section 7, costs estimates for a prototype system are provided in Section 8, and a summary and recommendations are presented in Section 9. Appendices include a discussion of the rationale for the development of telecommunications technologies and descriptions of five prototype systems; a chart summarizing the major activities associated with technological development and their attendant problems; and a telecommunications operations manual. (Author/CMV)

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Project No. 446AH50060
Contract No. OEC-0-74-7539

James W. Tawney, Ph.D.
University of Kentucky
730 South Limestone
Lexington, Kentucky 40506

TELECOMMUNICATIONS FOR THE SEVERELY HANDICAPPED

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January 1977

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Office of Education

Bureau of Education for the Handicapped
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Major contributions to this project were made by a relatively small number of persons. Jim Cooley and Stan Aeschleman provided the technical expertise to get the systems up and running. Pat Cobb served to develop the prototype role of field liaison coordinator, through home visits. Marilyn Gall contributed to social service interventions, and played a major role in arranging health interventions. Lilly Burns had daily contact with the families as the Telecommunications Operator. Sandy Deaton monitored budgets and coordinated daily activities with such efficiency that sufficient funds for a small scale third year intervention will be possible for a limited number of participants. Joy Huston deciphered my handwriting and got this final report in print.

The staff of the Henry Clay School in the former Louisville Public School system assisted us in testing the prototype system before it was implemented across the state.

The University of Kentucky Center for the Handicapped volunteered to conduct extensive medical evaluations on all of the children. These examinations led to a variety of treatments which will make life more comfortable for the children involved. For the children who could not necessarily thank them, we take this opportunity to do so.

The field staff of the comprehensive care system went to great lengths to assist in obtaining referrals for the project. We thank them for their efforts and their sustained interest in the project's activities.

Finally, we thank the parents and families who permitted the intrusion of our technology in their daily lives. Whatever the resources within the home, a place was found for our learning environment, in the corners of kitchens, in the parents' bedrooms and other inconvenient places. Parents' cooperation and commitment to their children enabled us to meet our project commitments.

PREFACE

Final reports are prosaic documents (factual, unimaginative, dull, according to Webster's). This report is probably no exception. While factual, the content cannot convey the excitement generated by the opportunity to develop the first components of a futures oriented technology. That excitement is tempered, to some extent, by the frustrations encountered in the problem solving process. That, too, is missing from the report. Nevertheless, the careful reader will be able to tease out these factors and perhaps will glimpse, also, the potential of technology systems for the severely handicapped.

The primary objective of a final report is to describe what was accomplished, present the data, and suggest what should come next. This report will do that but will attempt some other objectives too. Bearing in mind that final reports may be doomed to collect dust on a shelf, the content of this document is designed for more active purposes. It reports what was accomplished during the two year award period. It contains tables of problems encountered and how they were solved -- to serve as a sort of do it yourself manual for others with similar interests. It contains a prototype model system, to serve as a blueprint for social planners searching for ways to meet desired goals. Some questions are raised, in summary, about the future of systems like this: "Who should nurture them, and for how long?"

In brief, when RFP 74-5 was advertised, we proposed that individually designed teaching machines, placed in homes and controlled by computer, might be a reasonable, and relatively inexpensive, way to reach children who were geographically or politically removed from educational opportunities. During the conduct of the project, the potential of the Telecommunications system for facilitating social service delivery and coordination emerged. Time will tell if these novel uses will generate support to bring a full scale system into operation.

ORGANIZATION AND ABSTRACT OF THE FINAL REPORT

Section One contains the justification for the project, abstracted critical components of the request for proposals (RFP) and a list of the major objectives proposed for the project. The remainder of the report is organized in chronological order. Section Two is comprised of a list of events and dates. Sections Three, Four and Five contain the procedures and outcomes, respectively, of system development, child referral and family demographic information, and instructional home intervention. A related activity, contributed services from the University Medical Center, is described in Section Six. Child performance profiles are listed in Section Seven. Section Eight describes cost estimates for a prototype system. The summary and recommendations are listed in Section Nine. Included in the appendices is a summary chart of major problems and their solutions.

CONTENTS

SECTION ONE: GENERAL INTRODUCTION

Historical Perspective 11

Key Elements of RFP 74-5 11

The Kentucky Response to RFP 74-5 13

The Relationship of the Kentucky Response to RFP 74-5 and Other On-going BEH Supported Research and Development Activities 13

The Original Justification for the Telecommunications Project 13

Additional Considerations in the Design of Coordinated Educational and Social Service Delivery Systems 15

Major Activities Proposed for the Development of the Kentucky Telecommunications Project 17

SECTION TWO: IMPLEMENTATION STRATEGIES

Overview 19

Chronology of Major Activities and Events 19

SECTION THREE: SYSTEM DEVELOPMENT AND IMPLEMENTATION

Introduction 22

Existing Hardware Components 22

Prototype and First Generation Modem Interface (parallel-to-series) Units Designed for the Kentucky Telecommunications Project 22

Leased/Purchased Telephone Transmission Equipment 22

Existing Software: ACT Language 22

Illustrations of the System 23

System Test-Start and Stop Points 31

Outcome of the System Test 31

SECTION FOUR: LOCATING AND SELECTING PROJECT PARTICIPANTS

Source of Referrals 36

Home Interviews 37

Project Staff Evaluation 37

Outcome of the Selection Process 37

Geographic Distribution 37

General and Family Home Environment Information 40

Socioeconomic Status 41

SECTION FIVE: PROCEDURES FOR DEVELOPING LEARNING ENVIRONMENTS AND INSTRUCTIONAL PROGRAMS IN THE HOME

Telephone Installations 44

Constructing Learning Environments in the Home 44

Preparing Materials for Conducting Instructional Programs 44

Response Devices/Teaching Machines Constructed for Use on This Project 49

Designing Specific Computer Programs for Each Child 57

Activating the Instructional Programs 57

Parent Intervention/Maintaining Operations Center in the Home 57

SECTION SIX: OUTCOMES OF FAMILY INFORMATION GATHERING AND CHILD INTERVENTION ACTIVITIES

Case Histories 61

SECTION SEVEN: CONTRIBUTED SERVICES FROM THE UNIVERSITY OF KENTUCKY CENTER FOR THE HANDICAPPED 101

SECTION EIGHT: COST ESTIMATES FOR A PROTOTYPE SYSTEM

Introduction 106

General Assumptions Underlying Cost Estimates 106

SECTION NINE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary 111

Issues Related to the Future of Computer-Telephone Telecommunications Systems 111

SECTION NINE CONTINUED

Which is the Appropriate Perspective on the Costs for a Computer-based Telecommunications System? 111

Can a Computer-Telephone Linkage be Effected for On-line Processing of Instructional Programming? 112

Does the System Work Reliably? 112

Will Telecommunications-Delivered Instruction Deliver a Better Education, in Comparison to Other Curricula and Delivery Systems? 112

What Content, Scope and Sequence Can Be Taught by This Computer System? 113

What Functions Does the Computer Perform in a Telecommunications Delivery System? 113

Is This System Designed to Provide a Type of Homebound Instruction Which Might Supplant, or Substitute for, a Public School Placement? 113

Conclusions and Recommendations 114

REFERENCES

APPENDICES

Educating Severely Handicapped Children and Their Parents Through Telecommunications

Major Activities Associated with Technological Development

Operation Manual

Dissemination Activities

SECTION ONE

GENERAL INTRODUCTION

Historical Perspective

Prior to 1971, the notion of education for the severely retarded and multiply handicapped received little attention from educators and professionals in community service agencies. This population was generally relegated to institutions at birth or shortly thereafter or received instruction in preschool or workshop programs operated by parent groups. In 1971, the Pennsylvania decision (PARC vs. the Commonwealth of Pennsylvania) precipitated the right to education movement and forced a change in educational delivery systems. As a consequence of that and other landmark decisions, similar suits have been filed in nearly every state, public schools have been charged with the responsibility to find and provide education for all handicapped children, due process safeguards have been written into legislation to insure that children receive appropriate educational programs, permissive early education has been written into the education laws of a few states, efforts have been initiated to develop personnel preparation programs, and a concerted effort has begun to find new and different ways to educate these children.

Shortly after the Pennsylvania decision, the Bureau of Education for the Handicapped (BEH) convened an ad hoc advisory meeting. The product of that meeting (BEH, 1972) was a set of recommendations for a comprehensive and coordinated approach to provide educational opportunities for children with severe handicapping conditions. That meeting, and those recommendations, affirmed a BEH commitment to the severely handicapped, and marked the beginning of several programs to serve this population, including a request for proposals (RFP) to develop telecommunications systems for severely handicapped children and youth.

Key Elements of RFP 74-5 (Telecommunications for Severely Handicapped Children and Youth)

This final report, as noted, has been written for a variety of audiences. Since few will have access to the original RFP, critical elements are included in the final report. This information will provide the reader with the purpose of the RFP.

> This procurement is for one or more demonstration projects employing telecommunications for severely handicapped children and youth.
>
> (p. 1)

> There exists among the handicapped, those children and youth whose physical, mental, and/or social skills have been so limited that they have largely been overlooked in the provision of services.
>
> (p. 1)

> The Bureau of Education for the Handicapped has established as a goal the provision of equal educational opportunities to all handicapped children. In order to realize this goal with respect to severely handicapped children and youth, the Bureau adopted the objective to enable such children and youth to become as independent as possible, thereby reducing their requirements for institutional care and providing opportunity for self-development.
>
> (p. 1)

> A severely handicapped child is one who, because of the intensity of his physical, mental, or emotional problems, or a combination of such problems, needs educational, social, psychological, and medical services beyond those which have been offered by traditional regular and special educational programs, in order to maximize his full potential for useful and meaningful participation in society and for self-fulfillment. Such children include those classified as seriously emotionally disturbed (schizophrenic and autistic), profoundly and severely mentally retarded, and those with two or more serious handicapping conditions such as the mentally retarded-deaf, and the mentally retarded-blind.
>
> (p. 2)

> Such severely handicapped children may possess severe language and/or perceptual-cognitive deprivations, and evidence a number of abnormal behaviors including: failure to attend to even the most pronounced social stimuli, self-mutilation, self-stimulation, manifestation of durable and intense temper tantrums, and the absence of even the most rudimentary forms of verbal control, and may also have an extremely fragile physiological condition.
>
> (p. 2)

> Proposals under this RFP should be directed toward those severely handicapped children and youth who are homebound due to restricted mobility or to other aspects of social performance or physical involvement.
>
> (p. 2)

> Additional elements or activities considered significant for the innovative application of media technology in the provision of services to severely handicapped children and youth may be addressed by the applicant.
>
> (p. 3)

Thus, it can be seen that, while general in scope, the RFP was directed toward demonstration of applications of technology and innovative methods to educate severely handicapped children in home settings. The RFP elicited seventeen responses, and five were funded. Tawney (in press) described those projects (Appendix A) which include telephone and video transmission systems utilizing workbook, computer generated, or video-taped instructional content serving delayed, retarded, crippled or health impaired, disturbed, cerebral palsied and multi-handicapped children, from birth to 21 years of age, who are located in urban, sparsely populated, rural, and/or geographically isolated areas.

The Kentucky Response to RFP 74-5

The objective of the Kentucky project was to develop prototype electronically controlled learning environments in home settings, to educate persons with assumed severe developmental retardation and attendant multiple handicaps (referred to in RFP 74-5 as severely and profoundly retarded).

The Relationship of the Kentucky Response to RFP 74-5 and Other On-going BEH Supported Research and Development Activities

Tawney (1972) initiated a long-term research and development effort, supported by a grant from the Division of Research, Bureau of Education for the Handicapped. A major component of that project was to design and implement an electronically programmed preschool for children who manifest severe developmental retardation and attendant multiple handicapping conditions. The instrumentation center for the preschool, a solid state system integrated with a minicomputer system, appeared to have the potential, after development of prototype linking devices, to control learning stations outside of the preschool. The response to RFP 74-5 proposed to place learning devices in home settings to educate (stimulate) young persons with severely retarded behavioral repertoires. In effect, the telecommunications project was proposed as an extension of technology developed for a model preschool in an urban setting to an innovative application in an early education system for remote, sparsely populated, geographically or politically isolated areas. The offerer proposed to share facilities with the Programmed Environments preschool project, share computer use, utilize the errorless programming model, and exchange staff expertise to facilitate the development of both projects.

The Original Justification for the Telecommunications Project

The intervention model for the telecommunications project was drawn from the rationale for the Programmed Environments preschool. That rationale was based on observations of the behavioral repertoires of children in typical day care programs, and the knowledge of results of the project which had attempted to ameliorate behavioral deficits through extensive programming strategies in natural (non-laboratory) environments. The list of behaviors often emitted by children with severe developmental retardation is included in Section Four. Generally, these persons exhibited high rates of stereotypic and self-destructive behaviors, and exhibited low rates of age appropriate independent functioning or positive social interaction behaviors.

The concept of programmed or prosthetic environments was first discussed by Lindsley (1964). Recently, numerous studies or projects have been reported which utilized extensive programming strategies in what might be termed programmed or prosthetic environments. Diverse in target populations, these included programmed environments for adults in mental health settings (Allyon and Azrin, 1968), programmed laboratory settings for "autistic" children (Ferster and DeMeyer, 1965), programmed learning environments for children in institutions for the retarded (Bijou, Birnbrauer, Kidder, and Tague, 1967), total educational environments (Ulrich, Louisell, and Wolfe, 1971), sheltered workshops for adult retardates (Screven, Straka, and LaFond, 1971), home community placements for delinquent children (Wolfe, Phillips, and Fixen, 1972), alternate educational facilities (Cohen, 1972), and programmed curricula for tutorial instruction of young trainable retarded children (Tawney and Hipsher, 1970).

Experiences during early phases of the Programmed Environments project identified problems related to managing children in traditional day care programs, and suggested that:

a. children with behavioral repertoires, as described above, require constant management in 1:1 situations.

b. effective instructional and behavioral management must be highly programmed, with careful attention paid to arrangement and sequence of antecedent and consequent stimulus events.

c. children with behavioral repertoires as described above are not likely to have highly reinforcing properties to adults who interact with them in instructional settings over long periods of time, a factor which makes it difficult for adults to maintain a high rate and quality of teaching behavior.

d. children, as described, have extremely "fragile" repertoires making it imperative that, when specific tasks (behaviors) have been learned, these behaviors be maintained by intensive learning activities in school settings and at home.

e. an adequate curricula is not founded on typical play type activities, but in a precisely defined set of learning tasks which begin with simple response building (shaping), and which proceed through complex and multiple discrimination training to traditionally conceived "academic" tasks such as language development, pre-reading behaviors, etc.

(Lake, 1974, p. 3)

Other factors considered necessary in the development of services on a national level were listed: the target population is heterogenous in age, functional level and types of handicapping conditions; limited in number, in terms of percent of the total population; geographically separated; easily recognizable at birth when observable biological defect is manifest; and finally, poorly served in present settings. It was suggested that the development of completely automated learning environments, designed to accommodate children from birth to such time as the environment might "accompany" the child to the nearest school, might be within the realm of current technology.

Thus, the telecommunications project was proposed to develop an educational delivery system with the capacity to begin programming immediately after the birth of an infant with observable and multiple biological defects. During the contract period, additional rationale for a telecommunications based delivery system have emerged and are discussed in the next section.

Additional Considerations in the Design of Coordinated Educational and Social Service Delivery Systems

This project was initiated to develop a prototype transmission system to link a computer to home placed learning devices via a telephone transmission system. During the contract period additional rationale for long-term development of a comprehensive and coordinated delivery system have emerged as publications on telecommunications technology have been prepared and as issues have been raised in presentations. At the same time, national attention has focused on the problems of unserved children, school districts are beginning to confront management problems in transporting severely handicapped children to public education facilities, early (infant) intervention is receiving increased professional attention, and the implications of normalization and community placement are beginning to impact on parents and service providers. In short, education for all handicapped children (0-21 years of age) is moving from a goal to reality. These events provide a broader perspective for the use of telecommunications technology and suggest additional rationale for the development of innovative systems.

Children Out of School

Right to education decrees set the stage for due process procedures which require identification of handicapped children. The report of the Children's Defense Fund (1974) illustrates how children remain unknown or become lost to school districts. PL 94-142 mandates a national effort to insure that due process is followed within each state. Child-find activities are being initiated in many states. If conducted with procedures sufficient to guarantee that the identification process is exhaustive, a large number of previously unidentified children are likely to become visible, particularly in rural and isolated areas. These new cases are likely to tax the ingenuity of the systems charged to serve them. Basically, from a set of alternatives, there will be no one best alternative which balances extensive travel time, amount of instruction available through a homebound (itinerant) service and the requirements of an adequate education. Telecommunications systems may reach into these areas, to provide daily contact with parents, daily, sequential computer generated instruction, and supportive liaison services which enable a small number of personnel to cover large geographic areas.

Early Detection

A potential long-term benefit of public information activities conducted as a part of child find is greater public and professional awareness of very young children with observable and multiple handicapping conditions which are likely to retard development without intervention. This awareness may spur early referrals by families and friends. The establishment of a telecommunications based system on a long-term basis, concurrent with public awareness, may increase the likelihood that members of the medical profession will refer infants at birth for intervention and related social service delivery.

Movement Toward "Earliest" Intervention

There is a growing awareness of the potential benefits of birth-onward intervention. While there is a conflicting data base in the history of infant learning research, recent reviewers (Fitzgerald and Porges, 1971; Hulsebus, 1971) and long-term studies (White, 1971) confirm that the infant is a conditionable organism. Positive results from early intervention (preschool) studies have been interpreted as providing a justification for early intervention. Several states have passed permissive legislation for intervention from birth. A present BEH (1975) report on research needs for the severely handicapped contains several recommendations directed toward infant learning, infant curriculum development, and research on futures oriented service delivery systems. These factors, in the absence of a well established empirical base, should accelerate the development of work with infants. A telecommunications system with the capacity to "follow a child home from the hospital" opens up areas of infant research in natural environments which have previously been closed to researchers. Further, daily contact between a family and a telecommunications based service delivery system may serve to coordinate and record a variety of interventions during the early years of life (Appendix A).

Coordinated Social and Educational Service Delivery - The Social Planners' Goal

American society is becoming universally sensitized to the rights of all children as child advocacy efforts grow, as children of working mothers spend more time in day care centers, as child abuse emerges as a significant social problem and as divorce rates continue to climb. Within this social context, the needs of handicapped children transcend single, independent intervention strategies. These factors are clearly described in the reports of a major national project on the classification of children (Hobbs, 1975a, 1975b, 1975c). Noting the fragmentation of services to families and children, the project recommends that, in contrast to a singular focus on individual children, social services should focus on helping families help children (p. 223). They recommend that a family should be able to register a handicapped child with an agency that would assume long-term responsibility for assisting the family in caring for the child. Registration should occur as soon as the handicapping condition is identified, and as early as at birth. The agency should define its role as helper to the family, to the child, and to other significant helpers in the child's life. Its task is to help make the ecological system work. The optimum location for the agency would be in the public schools.

(p. 226)

Tawney (in press) has described how a model center can be built around a telecommunications system to provide such a delivery system. That whole chapter (Appendix A) provides a blueprint for multidisciplinary educational and social service delivery.

Parents' Ability to Manage Their Children at Home

Deinstitutionalization, normalization, and community based planning efforts for the severely retarded appear to be based on a number of tenuous assumptions concerning parents' abilities to manage children with severe and multiple handicapping conditions. As Tawney (in press) noted, we have effected a 180° change in direction and left parents in a dilemma with respect to their roles and responsibilities. Until recently they have been encouraged to believe that the state should assume responsibility for their child. Now, they are told that the child is their responsibility, and that community services will be developed to assist them with the task of raising their child. The dilemma is nicely put in The Futures of Children (Hobbs, 1975) which, as noted, recommends helping families help their children. Their recommendations are directed to strengthening families (p. 224) but acknowledge that "...mothers cannot do it all" (p. 225). It is apparent that the scope of responsibility is as yet undetermined in many circumstances. This raises the question of how much parents should be expected to do to educate and manage their child.

Further, there appears to be an assumption that most parents will evidence sufficient adaptive behavior to manage themselves and their children. However, that assumption does not necessarily hold. And, while there are many tasks which parents can be taught to enable them to teach their children self-help and other skills, it is not necessarily reasonable to expect them to assume the responsibility for providing daily, sequential instruction under the highly precise conditions necessary to facilitate learning. It appears more reasonable to provide a system such as telecommunications which can deliver instruction, and which can be utilized to assist parents in a variety of ways. The costs of providing comprehensive parent assistance is unknown. One factor, however, is known. A professional person who is driving from one locale to another is not, during this travel time, delivering assistance. Effective use of professional staff time can be facilitated by coordinated delivery systems.

Major Activities Proposed for the Development of the Kentucky Telecommunications Project

The context of this project, elements of RFP 74-5, the major objective of and justification for the project have been described. In brief, the offerer proposed these activities during the first year:

1. To develop and test a prototype device (parallel-to-series unit) to link the Interact computer system with the telephone system to establish a telecommunications transmission system.
2. Design a simple response recording device to test two-way communication between a remote site and the project site.
3. Contract for the production of tested, first generation parallel-to-series units.
4. Identify children for full-scale operation for year two.

and these for year two:

1. Implement the system on a full-scale basis.
2. Solve and record instrumentation problems.

3. Collect data on child performance.

4. Train parents to use the system.

5. Evaluate and report the outcomes of the project.

Subsequent sections of this report describe how these activities were conducted, the results and the future of the telecommunication system.

SECTION TWO

IMPLEMENTATION STRATEGIES

Overview

The general strategies for project implementation have been described. The specific steps and major events are listed in chronological order, along with the date of completion. The listing will serve these purposes: (a) to enable project officers to check this list for congruence with the activities listed in the project proposal, (b) to enable persons considering similar undertakings to identify problems which must be accounted for on technology development projects such as this, and (c) to show the effect of major events on the implementation of major activities. The outcomes section contains additional descriptions of the implementation problems.

Chronology of Major Activities and Events

Year One

1.	Proposal submitted	3/1/74
2.	Change in project start date	6/1/74 to 7/1/74
3.	Notification of award	6/21/74
4.	Initiation of orders for prototype p-s unit	6/21/74
5.	Project start date	7/1/74
6.	Resignation of key staff member	7/31/74
7.	Search initiated for key staff member	8/1/74
8.	Scheduled delivery date for p-s unit	10/1/74
9.	Employment of replacement for key staff member	11/15/74
10.	Actual delivery date for p-s unit	1/27/75
11.	On-site system test conducted and failed	1/27/75
12.	Equipment returned to factory	1/27/75
13.	System test run and passed	2/10/75
14.	In-house test on computer-telephone-apparatus link	2/11 - 2/24/75
15.	BEH program staff visit to project	2/13/75

16.	BEH site visit report received by project	(none received)
17.	Prototype p-s and simple apparatus installed for one-month test of local line transmission	2/25/75
18.	BEH change in due date of continuation report	from 4/30 to 3/17/75
19.	Continuation submitted	3/13/75
20.	Projected continuation notification date	4/15/75
21.	Notification of continuation received	6/18/75
22.	Long distance transmission test intiated	3/31 - 6/1/75
23.	Projected delivery of all first generation equipment	7/15/75
Year Two		
24.	Orders for remainder of equipment initiated	7/1/75
25.	Child-find initiated	7/1/75
26.	Child-find conducted continuously and completed	9/30/75
27.	First installation completed	9/4/75
28.	All equipment received	3/1/76
29.	Final installation completed	3/9/76
30.	Failure of multiple line system after receipt of modems	10/22/75
31.	Replacement modems received and modem-telephone line link found to be inoperative	11/12/75
32.	Complete analysis of computer-modem-data access arrangement by modem supplier and telephone company (wiring errors noted)	11/20/75
33.	Modem supplier field engineer evaluation of transmission system	12/3/75
34.	Phone company rewiring completed	12/9/75
35.	Full-scale implementation effected	3/9/76
36.	BEH program staff visit to project	12/17/75
37.	BEH site visit report received by project	(none received)

Several key factors emerge from an analysis of the chronology of events. During the first year, delays were experienced in receiving prototypes, and an extended time period was required to remedy the design errors in them. However, those problems were overcome, and reliable local and long distance data transmission was accomplished. Notification of funding, delayed until two weeks before the end of the first contract period, significantly affected planning for, and initiation of, child-find activities. During year two, with a statewide search for candidates compressed into this time period, the first installation was completed two months after the start of the award period. For approximately two months (10/22 - 12/9/75) a discrepancy in both telephone and communications suppliers specifications created continuous system malfunctions. Full-scale implementation was accomplished; and these data are reported in Section Six.

SECTION THREE

SYSTEM DEVELOPMENT AND IMPLEMENTATION

Introduction

The major objective of the project was the technological development of hardware and software components necessary to deliver instructional programs via telephone lines. The major components of the system included the computer hardware and software; time shared with another BEH supported project; interfacing devices enabling the computer-telephone transmission system link; and standard data access equipment, including hardware modems and acoustic couplers.

Existing Hardware Components

The Interact system, designed by BRS/LVE, contains: 1) a Nova 1200 minicomputer with 12,000 words of core memory (Data General Corporation); 2) a main frame consisting of a pre-wired card file for accommodating up to 8 stations, master power supplies, system clock, probability generator, and interconnecting cable; 3) 2 ASR-33 model teletypewriters with paper tape punch (Teletype Corporation); and 4) a high speed paper tape reader.

Prototype and First Generation Modem Interface (parallel-to-series) Units Designed for the Kentucky Telecommunications Project

The major task for the first year of the project was to build a device to link the computer and home placed learning devices to the telephone system. This requires two devices arbitrarily called modem interface or parallel-to-series units and designated as model 531-R (remote) and 53-L (local). Each local contains logic cards which permit the computer to interact with hard-wired and acoustic coupled modems.

Eighteen remote stations were built, essentially three for each local station. At any one time, there is a 1:1 link between a local and a remote. It was planned that there would be a 6 hour instructional day, and that each family would have access to two hours of transmission time. Thus, three homes, each containing a remote station, would interact with the local, thereby requiring a 3:1 ratio between remote and local units.

Leased/Purchased Telephone Transmission Equipment

Telephone transmission equipment included six CBT data access arrangements, models PC 1001 B and 1001 D, leased from General Telephone Company; 18 acoustic coupled modems, model 7103-LC-3 and 6 hard-wired modems model 7103-LC-4 purchased from Teledynamics Corporation.

Existing Software: ACT Language

ACT language is a computer language written especially for the process control and data recording of behavioral experiments. It is implemented on small, general purpose digital computers such as the Data General Corporation NOVA 1200. ACT language is described as simple and easy to learn. A behavioral scientist with no computer skills can quickly master the programming techniques and then write programs in natural English to produce the most complex procedures.

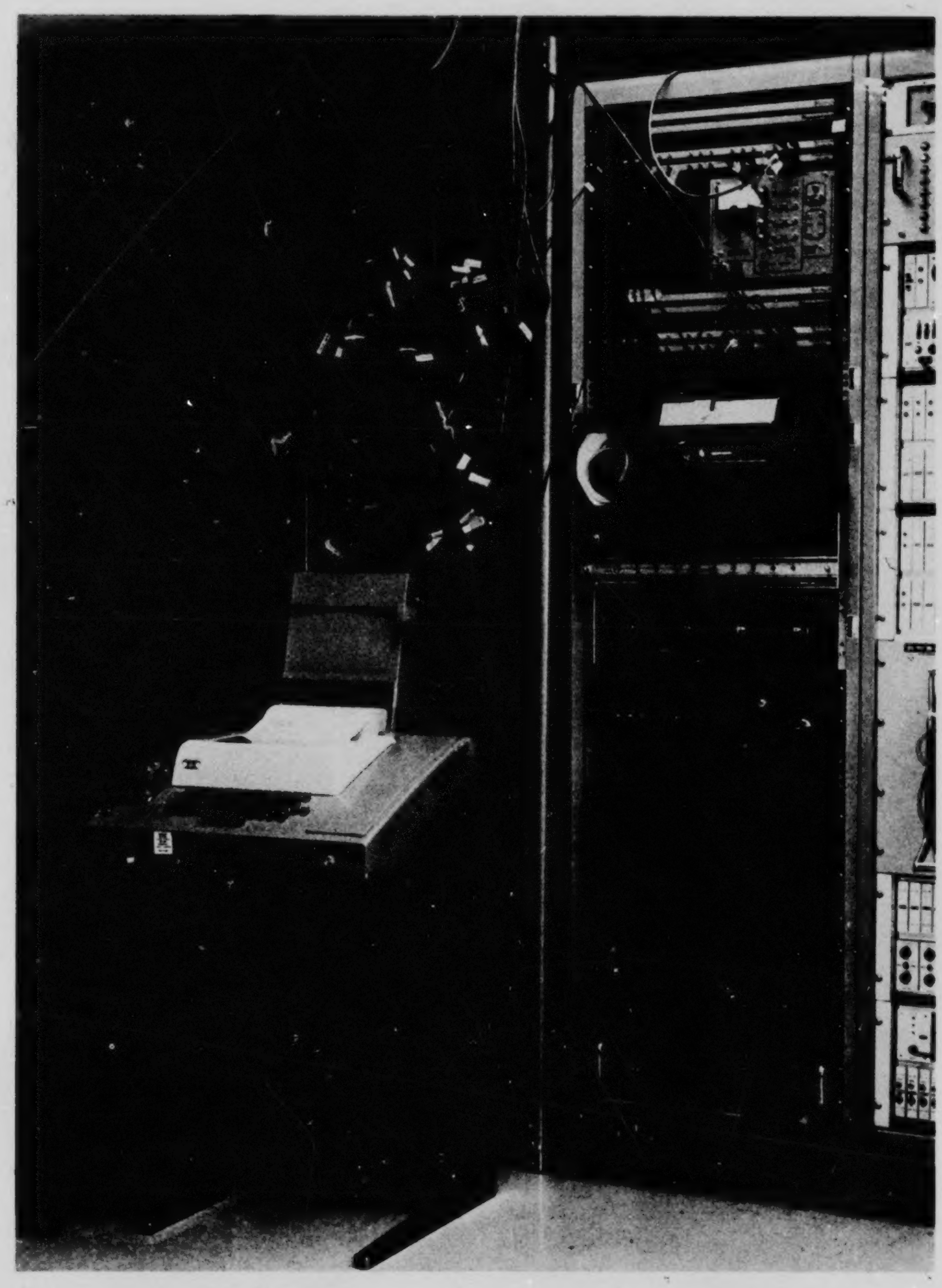
ACT is primarily a control language and not a statistical reduction language. That is, almost any type of apparatus can be controlled by this language through the digital computer and Interact interface hardware. Consequently, this system enables the user to continuously monitor data and control variables that affect behavior. For example, a user may continuously monitor the number of responses a child is making during a session and change the response/reinforcement ratio at any time during that session. Another of the properties of the ACT language is that it requires relatively little K memory to store the language, thus leaving more memory for programming.

However, other languages, e.g. COBOL, FORTRAN, ALGOL, can be read on the system by taking the ACT language out of memory and replacing it with the desired language. As each language is contained on paper tape, the operator can change languages by setting the appropriate starting address on the computer and reading the tape containing the desired language through the high speed tape reader. This operation can be completed in a few minutes.

Illustrations of the System

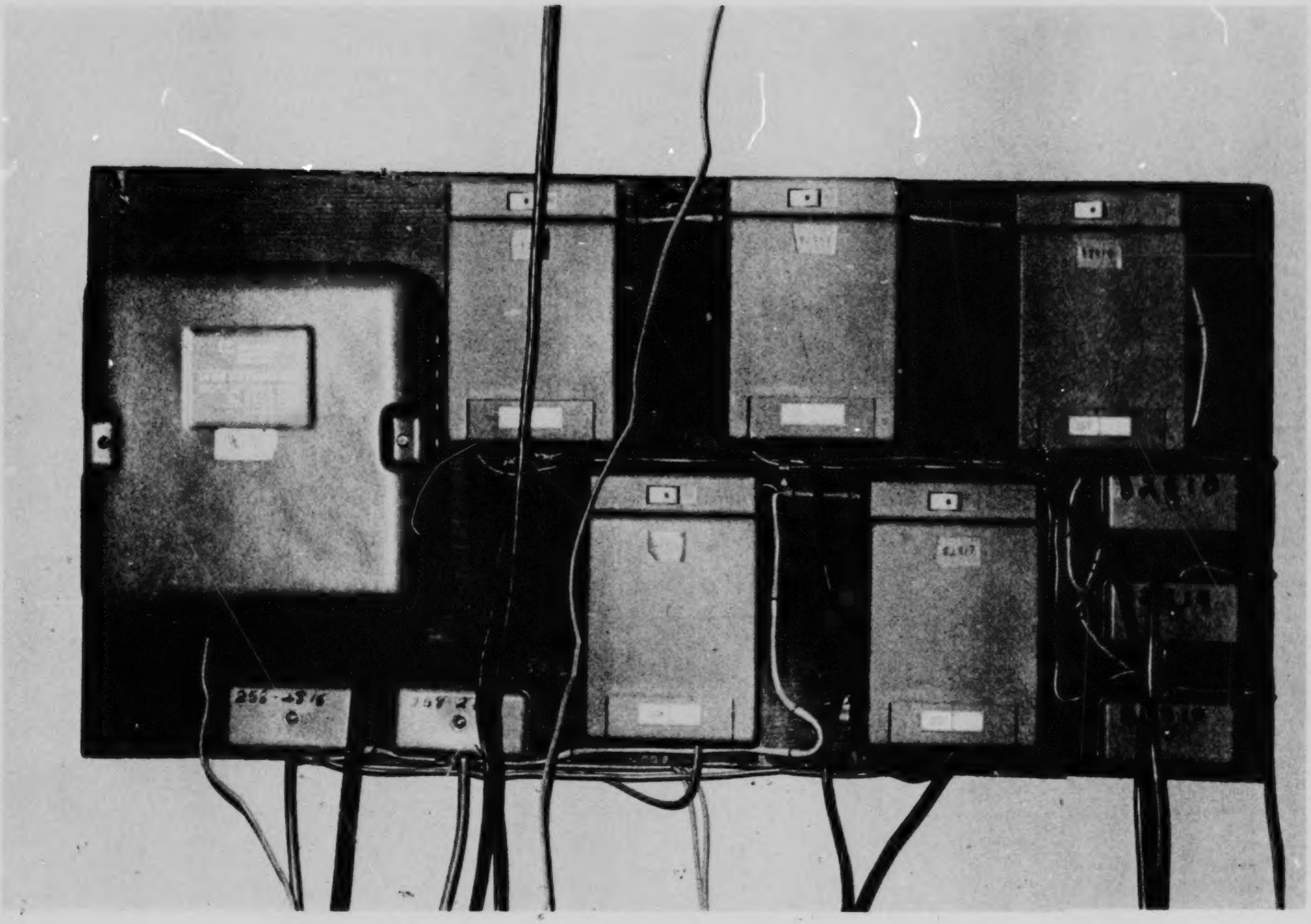
The components are shown in the following series of photographs. Figure 1 is a photograph of the computer, tape reader, teletype and 3 local stations. Figure 2 shows the CBT data access arrangements. Figure 3 shows the arrangement of telephones and hard-wired modems. Figure 4 is a block diagram which shows schematically how the different components are interconnected in the central location (left portion of the figure) and in the homes of the children (right portion of the figure).

Figures 5, 6 and 7 show the components placed in each home; the remote modem interface and power supply (Fig. 5), the acoustic coupler modem link (Fig. 6) and one of the response devices (Fig. 7).



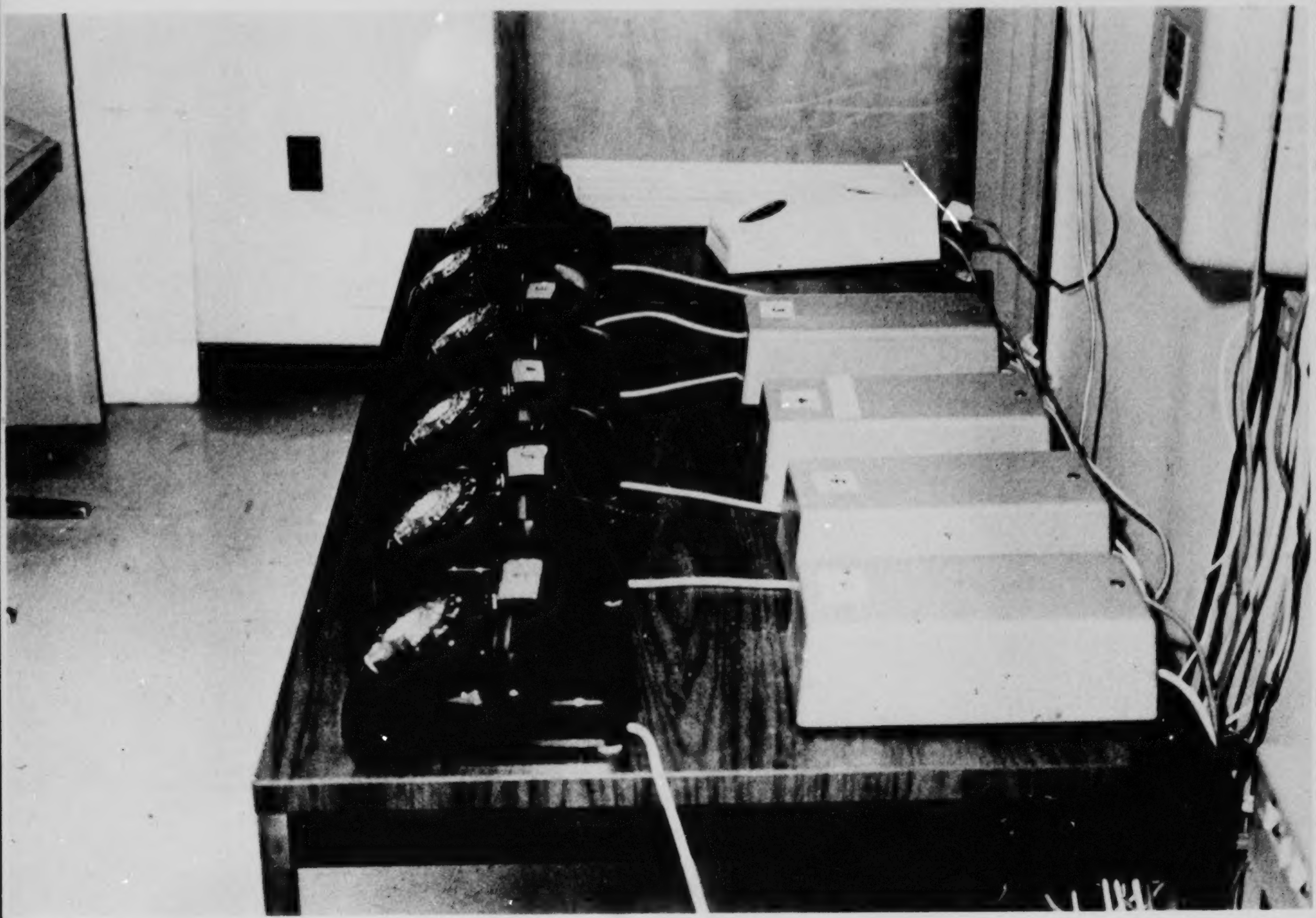
REMOTE TELETYPE AND NOVA 1200 COMPUTER
AT CENTER

FIGURE 1



DATA COUPLERS AT CENTER

FIGURE 2



MONITOR TELEPHONES AND ACOUSTIC COUPLER AT CENTER

FIGURE 3

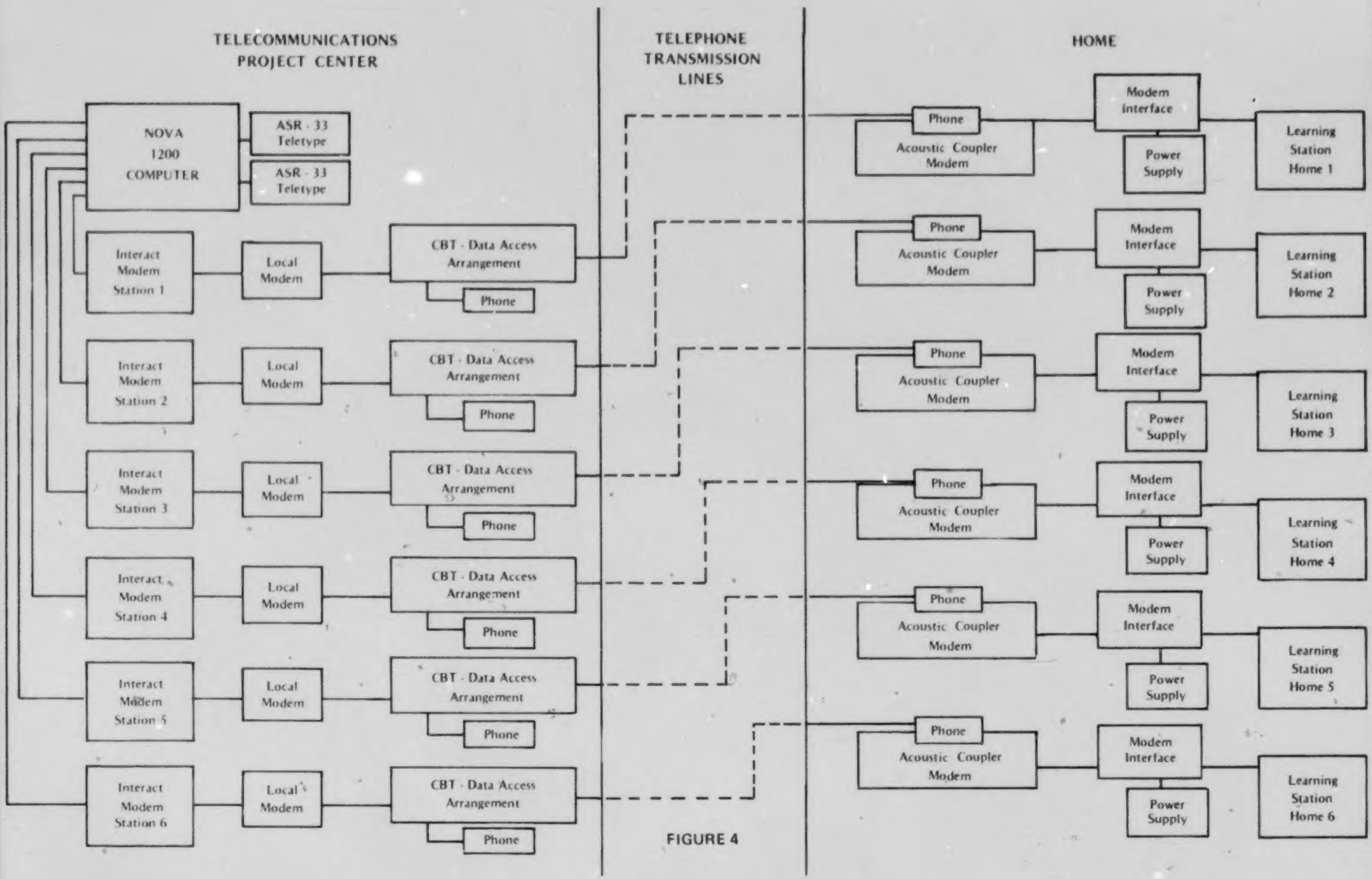
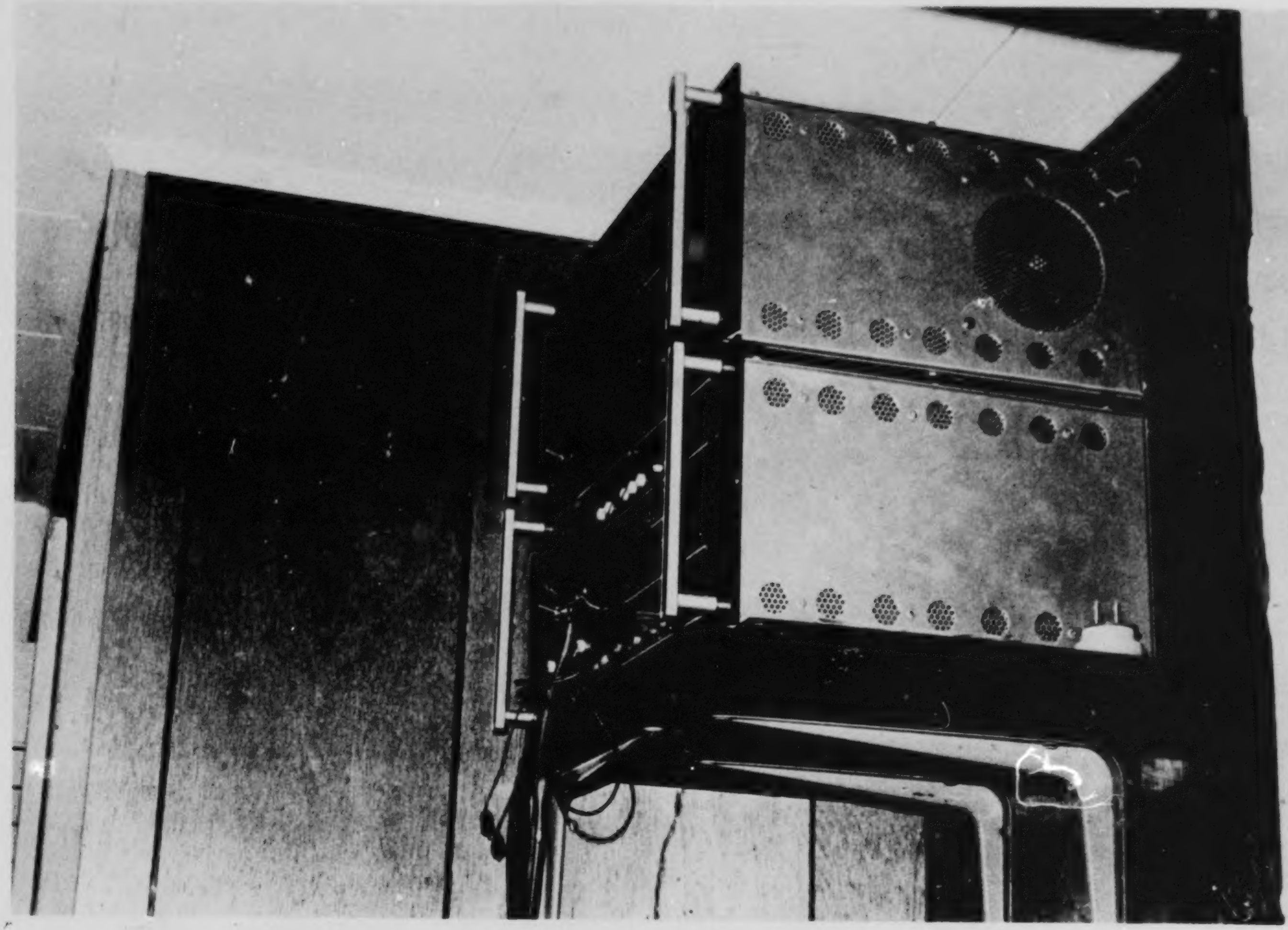
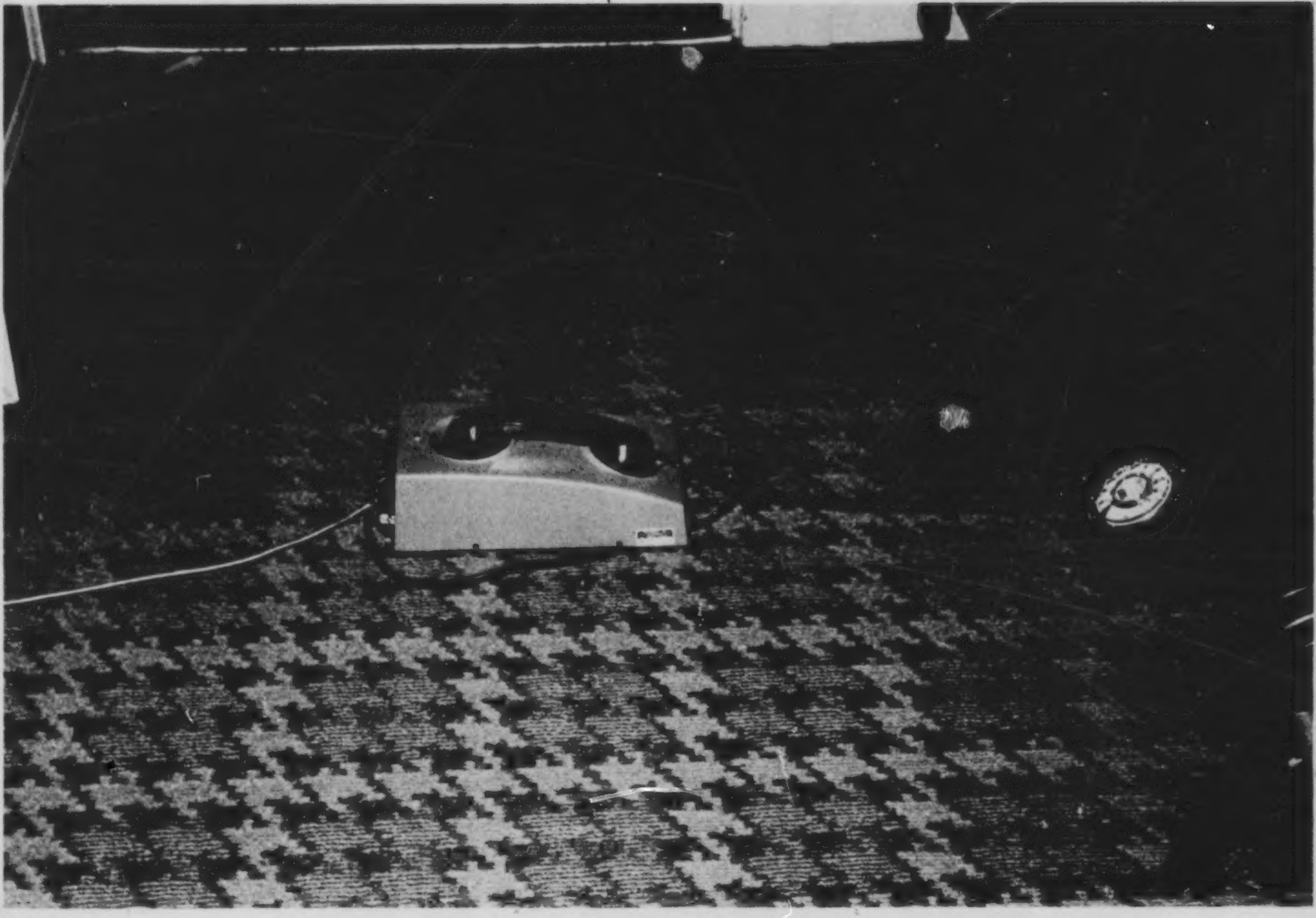

TELECOMMUNICATIONS PROJECT CENTER
TELEPHONE TRANSMISSION LINES
HOME
NOVA 1200 COMPUTER
ASR - 33 Teletype
ASR - 33 Teletype
Interact Modem Station 1
Interact Modem Station 2
Interact Modem Station 3
Interact Modem Station 4
Interact Modem Station 5
Interact Modem Station 6
Local Modem
CBT - Data Access Arrangement
Phone
Acoustic Coupler Modem
Modem Interface
Power Supply
Learning Station Home 1
Learning Station Home 2
Learning Station Home 3
Learning Station Home 4
Learning Station Home 5
Learning Station Home 6

FIGURE 4



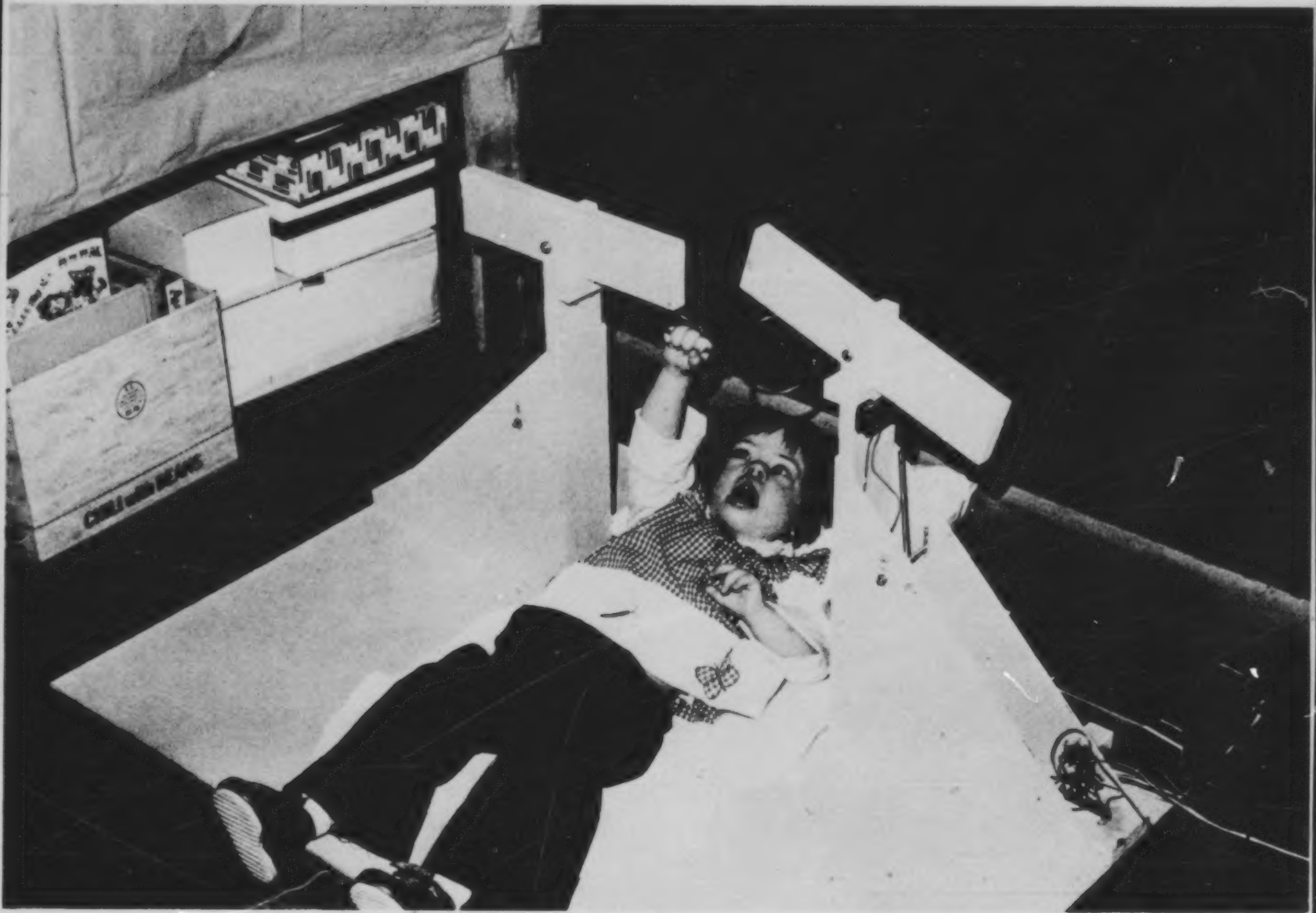
POWER SUPPLY IN THE HOME

FIGURE 5



HOME ACOUSTIC COUPLER AND TELEPHONE

FIGURE 6


CHILI with BEANS

1-6-w ON ARM-PULL
REINFORCER - MUSIC

FIGURE 7

System Test
Start and Stop Points

During the first year, system test was initiated when the prototype modem interface units (one local, one remote) were delivered, and ended when the public school year ended in Louisville, Kentucky (the location selected to test long distance transmission). Full-scale system test was initiated after all components of the system were constructed, or acquired, and presumably, each single component of the system was debugged. The problems encountered during the system test are listed in Appendix B. The system test was stopped on July 23, 1976, prior to the completion of the two year contract period.

Outcome of the System Test

The objective of the system test was to determine if the telecommunications system would work reliably on a daily basis. The outcome of the full-scale test period is shown in Table 1.

The number of days the apparatus was placed in the home is shown in Column A. The number of days when no lesson was presented because the child was ill or absent is shown in Column B. The number of days when no lesson was presented due to system failure is shown in Column C. From this information, the reliability of the system was determined for each user. Column D represents the number of potential days for lessons (A minus B). From that total, the number in Column C (system malfunction) was subtracted. The percent of potential lessons run is shown in Column F, representing the number conducted divided by the number of potential lessons.

The percentage of lessons conducted ranged from a high of 92% to a low of 42% with a mean of 69%. The unusually low percentages noted with a single asterisk are largely the result of an inability of phone lines in the children's areas to transmit data reliably. If these four scores are eliminated from the group total a more representative mean of 75% emerges. This figure suggests that, given a reliable modem to modem link, the system worked approximately 75% of the time.

The relationship between possible and actual program time is shown in Figure 8. This figure shows the cumulative possible minutes of program time and the cumulative actual program time across instructional days during the second year of the project. The cumulative possible program time is determined by summing the total number of sessions available for programming on each day and multiplying that value times 15, the average session length. This total was cumulated across days.

The actual amount of program time is determined in the same manner described above with the exception that only the sessions that were conducted each day were included in the total. The important relationship between the curves is the difference in slope at various points along the abscissa. A flattening of the actual program time relative to the cumulative possible program time reflects apparatus failure. If the system worked reliably 100% of the time, there would be a single curve. When there is a system failure, or when the home does not respond, a lower n of minutes is recorded, and the distance between curves increases. If the complete system were down for an extended period the curve would flatten for that time interval. The curves reflect three major phases during the project's second year. The first phase,

TABLE 1

PERFORMANCE SUMMARY

CHILD CODE	A Number of Days Apparatus in Home	B Number of Days No Lesson due to Inavailability of Child (illness, etc.)	C Number of Days No Lesson due to System Malfunction (apparatus failure, etc.)	D Potential Days for lesson (A minus B)	E Number of Lessons Conducted (D minus C)	F Percent of Potential Lessons (E ÷ D)
III-23-a	205	22	88	183	95	52*
III-21-d	200	42	91	158	67	42*
III-22-b	186	16	80	170	90	53*
I-3-z	170	100	27	70	43	61
I-6-w	158	33	28	125	97	78
II-8-u	144	44	8	100	92	92
II-17-k	143	24	17	119	102	86
I-16-1	131	72	13	59	46	78
II-20-f	124	29	25	95	70	74
III-7-v	122	29	29	93	64	69

PERFORMANCE SUMMARY (page 2)

CHILD CODE	A Number of Days Apparatus in Home	B Number of Days No Lesson due to Inavailability of Child (illness, etc.)	C Number of Days No Lesson due to System Malfunction (apparatus failure, etc.)	D Potential Days for lesson (A minus B)	E Number of Lessons Conducted (D minus C)	F Percent of Potential Lessons (E ÷ D)
I-9-t	120	45	37	75	38	44*
I-15-m	117	38	13	79	66	84
I-13-p	117	36	16	81	65	80
III-43-ab	81	20	31	61	30	50
II-17-ag	80	29	25	51	33	65
III-48-ab**	67	59	2	8	6	75
III-2-aa**	58	25	11	33	22	67
II-46-f	26	3	2	23	21	91

* Low percent due to a failure of modems to link up. See text for discussion.

** Children withdrew from program.

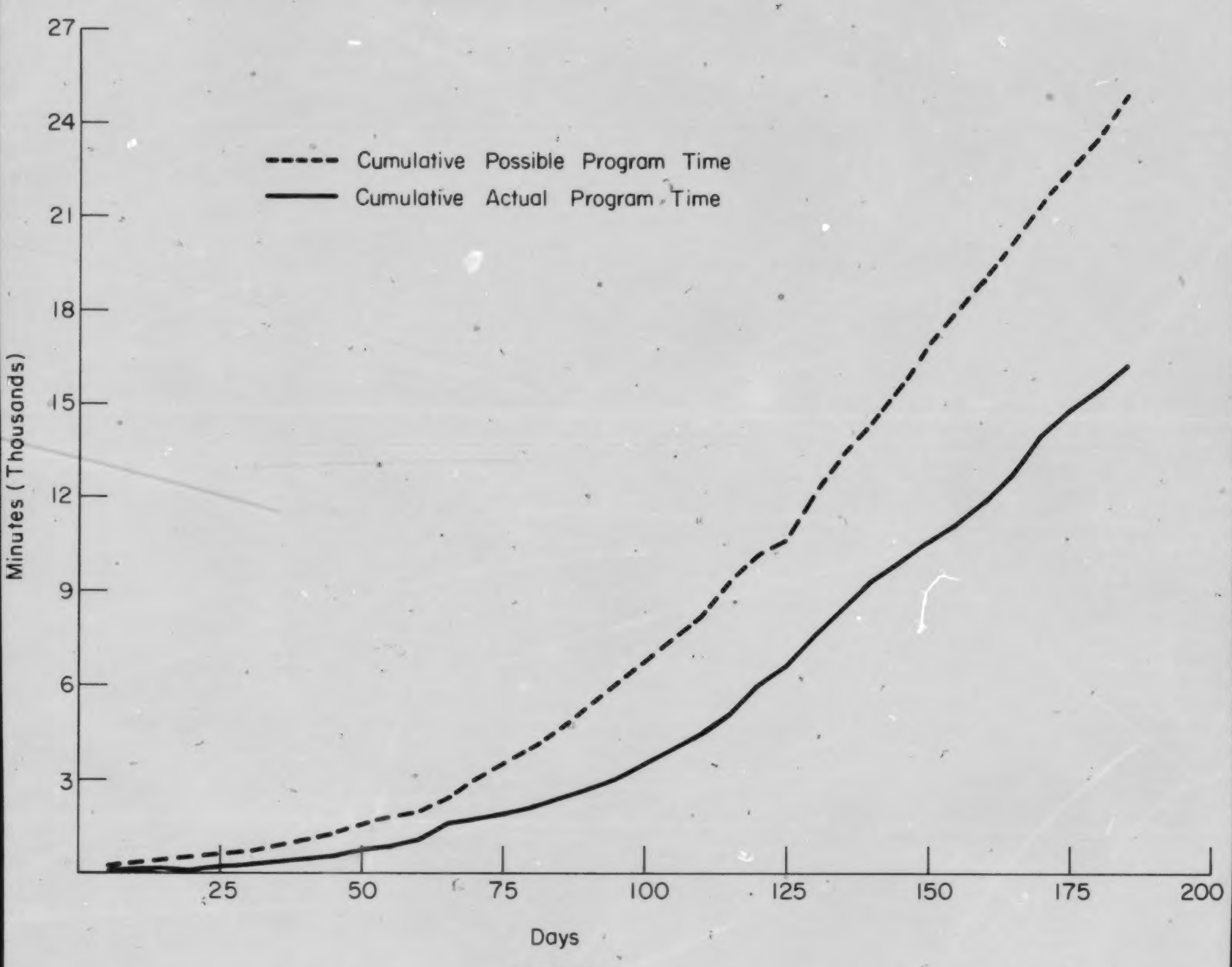

27
24
21
18
15
12
9
6
3
Minutes (Thousands)
25
50
75
100
125
150
175
200
Days
Cumulative Possible Program Time
Cumulative Actual Program Time

FIGURE 8

from session 0-60, shows that some problems existed from the beginning of home installation. The second phase, from session 60-110, when most of the apparatus had been placed in the homes, shows the problems experienced by project staff in troubleshooting and correcting hardware malfunctions. The cumulative actual program time curve is flatter relative to the cumulative possible program time during this phase than at any other time. At session 110, the slope of the actual program minutes began to steepen indicating that the majority of apparatus problems had been corrected and the system was running relatively trouble free.

SECTION FOUR

LOCATING AND SELECTING PROJECT PARTICIPANTS

This project proposed to serve eighteen children, 0-12 years of age, with severe developmental retardation and attendant multiple handicapping conditions, and, preferably, to serve predominately younger children. The behavioral descriptors for these children include:

1. Little or no vocal behavior
2. Limited gestural behavior
3. Limited self-help skills
4. Inconsistent or no bowel or bladder control
5. No obtained score on a standardized test
6. Limited social interaction
7. Inability to follow simple commands
8. No reciprocal social reinforcement of others in their environment
9. A high rate of superstitious behaviors
10. A high rate of disruptive behavior
11. Low rate of "constructive play behavior"
12. Attendant multiple handicaps

From this set, a limited set of minimal behaviors was derived for use in the referral process:

1. Vision (presumed ability to discriminate shapes)
2. Use of at least one limb without significant motor involvement
3. Below school age (0-6)
4. Not currently enrolled in an intervention program

After initial visits to several homes, an additional set of considerations was derived which influenced final selection of candidates; children's responsiveness to primary and/or social reinforcement; parents' and family members' apparent willingness to cooperate, and to manage their child's behavior, and to demonstrate a realistic view of the child's handicapping condition.

Source of Referrals

The referral process was scheduled to begin during the first year. It was delayed until notification of the continuation award was received, June 18, 1975.

Referrals for the Telecommunications project were obtained primarily through the comprehensive care system, fifteen regional community mental health/mental retardation centers which are operated by the Department for Human Resources. The initial contact was made with the Director of the Institute on Developmental Disabilities. Then, letters were sent to the executive director of each center requesting participation and assistance from appropriate staff, stating project goals, and listing the functional criteria. Letters were followed by telephone calls to the executive directors who then referred project staff to unit heads or field case workers.

These agency contact persons initially served as liaison between the Telecommunications staff and the referred candidates. The contact persons, in most cases, arranged the initial interview with the families and accompanied the Telecommunications staff on the initial interview.

Letters were also sent to, and referrals received from, the following agencies: (1) University of Kentucky Medical Center, Neonatology and Special Baby Clinic, (2) University of Louisville, Child Evaluation Clinic, and (3) selected Public Health regional offices.

Home Interviews

After an agency referred potential candidates for participation in the Telecommunications Project, project staff called the referral agency's contact person and arranged a time and date to interview families. Generally, the only information which was available was the child's name and in some cases that was unknown. Agency staff accompanied Telecommunications project staff to the potential candidate's home and assisted with the interview. In a few cases, the referring contact person neither accompanied project staff nor arranged the initial interview.

During the initial interview of the potential project candidate, project staff discussed the project purposes, goals and methods with the candidate's parents and/or guardians. The child was observed to obtain an estimate of functional level. Health and personal information were gathered. The home environment was examined to determine the possible placement of the learning apparatus and the need in the home for telephone installations or changes in the type of telephone. Parents were interviewed to determine their apparent willingness to participate in the project and were informed that they would be notified of the decision by mail.

Project Staff Evaluation

Subsequent to home visits, staff meetings were held to discuss potential candidates, to select participants, and to determine the type of instructional apparatus for each participant. All factors were taken into consideration, and an effort was made to select one candidate within each of the comprehensive care regions.

Outcome of the Selection Process

Fifty-three infants and young children were referred between July 1 and September 30, 1975. Twenty-two referrals were not seen, for reasons shown in Table 2. Of the thirty-one children who were seen by project staff, thirteen were not accepted for the reasons shown in Table 3.

Geographic Distribution

The location of the families is shown in Figure 9. Kentucky has several definite geographic divisions causing the land and resources to dictate the socioeconomic status of its residents. The child-find activities were conducted throughout the state, and children selected represented a wide geographic

TABLE 2

REFERRALS NOT INTERVIEWED BY PROJECT STAFF

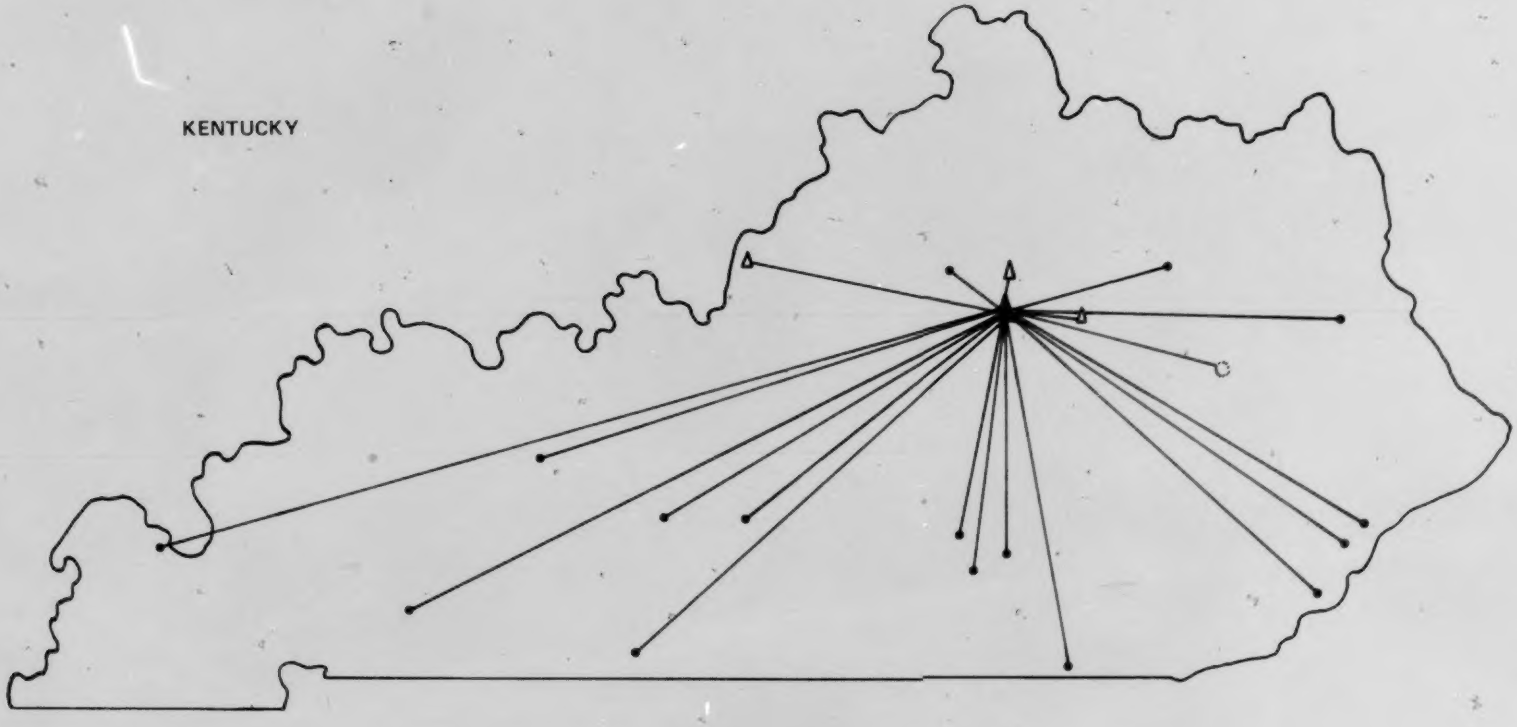
Number	Reason Referrals not Interviewed
1	died before interview was set up
2	other participants were selected before an interview was arranged
2	names removed by referrer because of lack of parental interest in project after referred
2	overconcentration of applicants in geographic area
2	not at home for interview
13	over age limit
22	Total

TABLE 3

REFERRALS INTERVIEWED BY PROJECT STAFF BUT NOT ACCEPTED

Number	Reason Referrals not Accepted
2	misinformation obtained on age, child over age limit
2	child did not respond to any reinforcing events
2	parents chose not to participate
3	participating in another intervention program
4	functional level at near normal
13	Total

LOCATIONS OF TELECOMMUNICATIONS PROJECTS PARTICIPANTS



▲---Lexington
△ ---Children who withdrew after set up completed
● ---Children set up and working
○ ---Child accepted not set up

FIGURE 9

spread except for the northern Kentucky region. Six children were dispersed across the Cumberland Plateau region (Appalachian Mountains) which is mountainous and rural, and the major industries are centered around "deep" and "strip" coal mining. Though major highways in this area have been improved in the past few years, five of these six children lived in isolated areas, one of which could only be reached by walking the last half mile and crossing a crude swinging bridge.

Four children were clustered in the Southeastern part of the state at the base of the mountains. This area also has coal mining, but there is some tobacco and livestock farming, some small industries, and recreational facilities are centered around lakes, forests and historical tourist attractions. Even in this area, where the topography is more gentle, only one child lived in a small town -- the rest of them lived in isolated areas.

Five children were spread across the Southwestern part of the state which is sparsely populated, with only one town having a population larger than 25,000. This part of the state has a few large strip mines but is usually known for its general farming. Though the area is more level and highways are more accessible than in the eastern part of the state, social and educational services are often lacking because of distance and the sparse population.

One child was located in the far western part of the state in a small town of approximately 32,000 population and about three hundred fifty (350) miles from the Telecommunications center.

The Central Kentucky area, including Louisville, Frankfort and Lexington, is one of the two metropolitan areas of the state. Industries in this area are related to tobacco products, livestock, distilling, chemicals, farm machinery and food processing.

A case history was developed on each project participant and is reported in another section. A review of each case history reveals that the project served children/families from a wide socio-economic status scale ranging from a scale value of II to a scale value of V using the Hollingshead and Myers (1948) formula to arrive at an index of Social Position.

General and Family Home Environment Information

Project children lived in a variety of home environments, including mountain cabins, mobile homes, farm houses, apartments and six-room brick homes in subdivisions. Parent's educational histories range from third grade to a masters degree in education. Three parents received their high school diploma by taking the General Equivalency Degree (GED) and three others attended a vocational school. Father's occupations included three unemployed persons, one teacher, one business manager; the remainder worked as laborers. Only three of the mothers were employed outside the home.

The youngest parent was 15 years old and the oldest was 62 years with the median being 30 years of age. Marital status included two parents who were single, natural parents, married, divorced. Twenty-five percent of the parents had had previous marriages. Twenty-two of the forty-four living siblings in the homes were not full blooded brothers or sisters. Primary caretakers included the natural parents, grandparents, foster parents, hired baby-sitters and various other relatives.

Socioeconomic Status

The right to education and normalization movements are predicated on the assumption that the home and community are the proper environments for children with severe and multiple handicapping conditions. As an additional strategy to describe the social environment of the children in the project, their class status was ranked on Hollingshead's Index of Social Position (Hollingshead and Redlich, 1958), a widely used measure. This measure is based on three assumptions:

> "1. Social stratification exists within the community.
>
> 2. Status positions are determined mainly by a few commonly accepted cultural characteristics, and
>
> 3. Items of status may be scaled and combined by the use of statistical procedures so that a researcher can quickly, reliably and meaningfully stratify the population."
>
> (p. 67)

> This index uses three criteria to determine class position: the residential address of a household, the occupational position of its head, and the years of schooling the head has completed.
>
> (p. 67)

Class position is determined by a formula which assigns a weight to each criteria, multiplies the weight with an assigned scale value, sums the scores for each criteria, and ranks the sum of scores (Hollingshead and Redlich, 1958, pp. 287-387). Table 4 lists the factors and weights. Table 5 identifies the cut-off point for each class.

TABLE 4

FACTORS AND WEIGHTS DETERMINING CLASS POSITION

Factor	Weight
Residence	6 x Scale Value
Occupation	9 x Scale Value
Education	5 x Scale Value

TABLE 5

RANGE OF SCORES DETERMINING CLASS POSITION

Class	Range of Scores
Upper Class I	20-31
Class II	32-55
Class III	56-86
Class IV	87-115
Lower Class V	116-134

Project staff utilized the index after visits had been made to the home and extensive information had been gathered. The residence factor was determined by an arbitrary assessment of housing taking into account material values, neighborhood, percent of maintenance and type of furnishings. For example, on a scale of 1 to 7, a #1 residence would be valued at approximately $65,000 or more in a neighborhood of other homes similar in value, well maintained and well decorated. A #7 residence would be a one-room lean-to in need of repair and improvements.

Table 6 contains the scores in rank order from highest (upper) to lowest scale score. The number of families in each class rank is shown in Table 7.

TABLE 6

CLASS POSITION OF PROJECT FAMILIES

Scale Score	Social Class Status
47	II
55	II
60	III
93	IV
98	IV
98	IV
98	IV
107	IV
107	IV
112	IV
113	IV
113	IV
119	V
128	V
128	V
128	V
128	V
129	V
129	V

TABLE 7

NUMBER OF PROJECT FAMILIES IN EACH CLASS RANK

Class Rank	Number of Families
I (upper)	0
II	2
III	1
IV	9
V (lower)	7
	19

The information in this set of tables indicates that the socioeconomic environment of the families falls predominately at the lower end of the scale. It should be noted that no attempt was made to obtain a representative sample from each socioeconomic level. Nor is this information intended to infer that the status of these families would be reflected in the distribution of another group. Instead, this analysis was conducted to demonstrate, from another perspective, that these families, for the most part, have limited resources. As shown, educational levels are predominately low, many are unemployed and receiving a variety of social welfare services or are employed in unskilled professions. Yet these families, many of them marginal in adaptive behavior, are maintaining their children in the home. No reasons are offered here to explain this, it is sufficient to indicate the status of the families.

SECTION FIVE

PROCEDURES FOR DEVELOPING LEARNING ENVIRONMENTS AND INSTRUCTIONAL PROGRAMS IN THE HOME

Telephone Installations

In some instances, the project supported the cost of a telephone installation. Project staff made arrangements with local telephone companies and installed learning devices as soon as the telephone system was in operation.

Constructing Learning Environments in the Home

General specifications for learning environments were written during the parent interview visit to the home, and a tentative location was agreed upon. When the installation was made it was necessary to:

1. relocate the telephone in some instances
2. establish a secure location of the instrumentation in proximity to the phone
3. complete minor wiring
4. link the components and test them

Parents observed the process and went through the steps required to activate the system. Staff modeled the correct responses, verbally prompted parents as they went through the process, and prepared written instructions for them (Appendix C). When parents demonstrated that they could activate the system, the child was introduced to the learning environment. Project staff demonstrated, then assisted parents as they went through the process with their child.

Finally, when parents and child were engaging the apparatus correctly, the written agreement to participate was completed, additional information for the child and family history was obtained, a schedule for daily sessions was prepared, and a return visit was scheduled. Project staff returned to site, and programming was initiated the following day.

Preparing Materials for Conducting Instructional Programs

As noted, three basic types of apparatus were designed for use with the children. During the first home visit, a general assessment of the child's assets and deficits was obtained. Figure 10 shows the sequence of events required to prepare the apparatus and computer program for installation and use in the home. The apparatus have been described. Five basic instructional programs were generated, as shown below.

Arm Pull

Objective: The child when placed under rings on the apparatus, will reach, grasp and pull the rings toward himself.

STEPS IN INSTRUCTIONAL PROGRAM DEVELOPEMENT

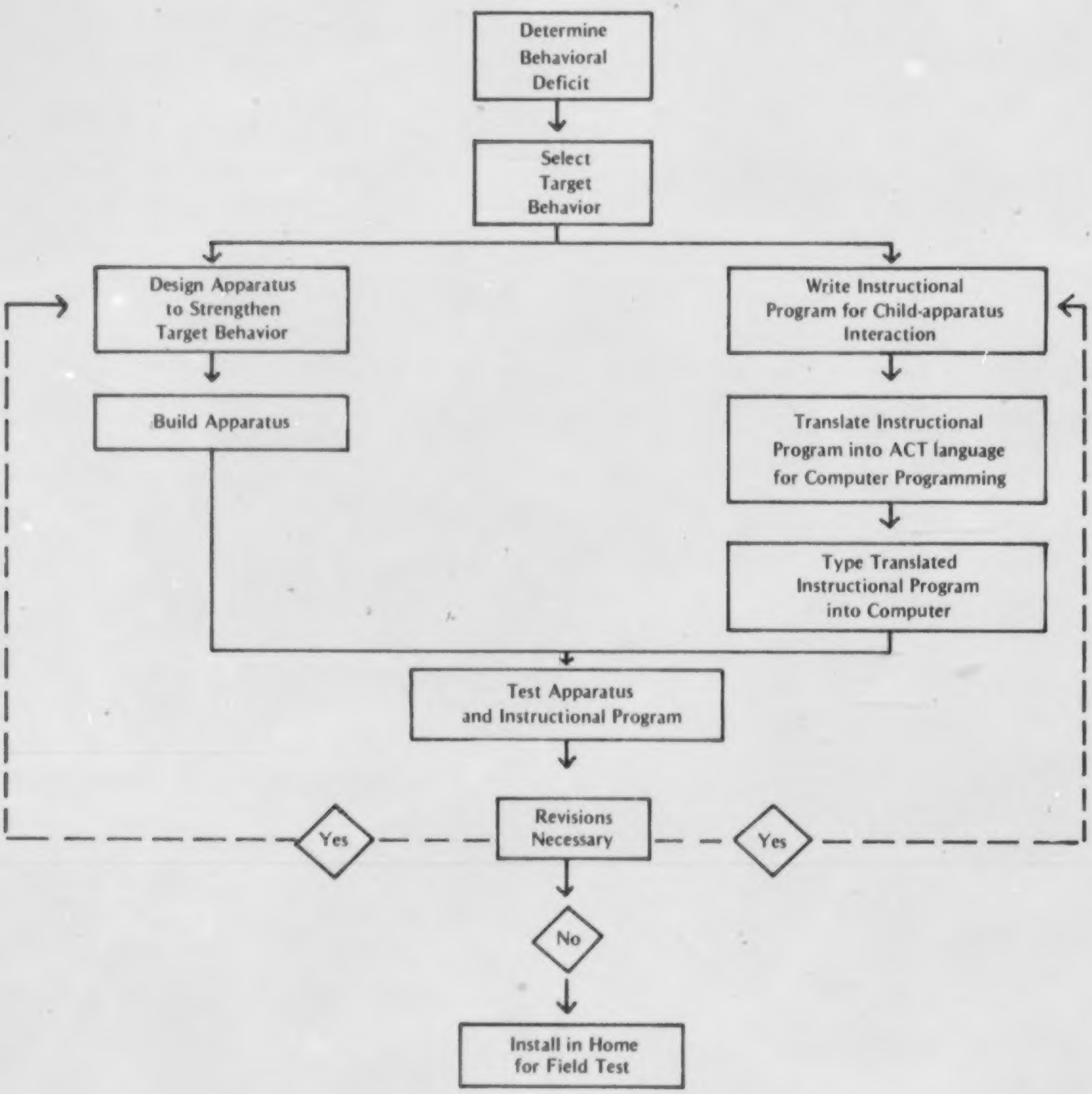

Determine Behavioral Deficit
Select Target Behavior
Design Apparatus to Strengthen Target Behavior
Build Apparatus
Write Instructional Program for Child-apparatus Interaction
Translate Instructional Program into ACT language for Computer Programming
Type Translated Instructional Program into Computer
Test Apparatus and Instructional Program
Revisions Necessary
Yes
Yes
No
Install in Home for Field Test

FIGURE 10

Rationale: The increase in tension facilitated the strengthening of muscles in not only the arms but chest, shoulders, back and neck as well. All are necessary for activities to pull self up, crawl, feed, etc.

Procedure: After the child is placed in a supine position, responses on either pull ring provide reinforcement. The amount of force required to activate the microswitch is adjusted to accommodate the child's strength. As the child continues on the program the force and number of responses necessary to produce reinforcement is increased. Session duration is varied from 10-20 minutes.

Parental Responsibility: The parent follows the instructions for operation of the apparatus and then places the child supine with shoulders directly under the hand loops. The parent then starts the program.

Kick Panel

Objective: The child, when placed supine with his torso perpendicular to the panel, his legs slightly flexed and his feet resting lightly against the panel, will extend his legs as in kicking and move the panel.

Rationale: It is necessary to strengthen leg muscles and have flexibility in the lower extremities as a prerequisite to such activities as crawling and walking.

Procedure: After the child is placed in a supine or prone position, kicks to the panel produce reinforcement. The force required to activate the microswitch is adjusted to accommodate the child's strength. As the child continues on the program the force and number of responses necessary to produce reinforcement is increased. Session duration varies from 10-20 minutes.

Parental Responsibility: The parent follows the instructions for operation of the apparatus and then places the child in the proper position. The child is placed supine with legs raised and feet resting against kick panel. A pillow is placed between the child's head and the crib headboard to prevent the child from easing away from the panel. The parent then starts the program.

Match-to-Sample I (Brightness Matching)

Objective: The child, when presented with three windows containing two stimuli of equal intensity and one with a different intensity, will press the two matching windows.

Rationale: The behavior being taught, a match-to-sample response, is assumed to be a prerequisite for letter discrimination; part of a sequence of more complex discrimination programs to teach reading behavior.

Stimulus Material: The brightness program contained 48 slides - 24 observing and 24 matching slides. When projected onto the plexiglass windows the observing slides produce either a white top window and black bottom windows or a black top window and white bottom windows. Correspondingly, the matching slides either produce a white top window and one white and one black bottom window or a black top window and one white and one black bottom window. Thus, the child is required to match two white stimuli on half the trials and two black stimuli on the remaining trials. Stimulus location is determined quasi-randomly.

Procedure: The child is seated in front of the apparatus and an observing slide is presented. Immediately following an observing response a choice slide is presented. A correct response terminates the trial and produces reinforcement, the clown eyes flashing for 2 seconds. Incorrect responses have no immediate consequence; the slide remains in effect until a correct response occurs. Trials are interpolated by a 4 second time-out during which all windows are darkened and all responses are unreinforced. Sessions terminate after 20 minutes or when the child completes the slide program.

Parental Responsibility: Parents are given the following instructions for operation of the apparatus. After the phone is placed in the acoustic coupler, the child is placed before the panel. If the child does not make a response, the adult is to prompt by guiding the hand and gradually fade the prompt as the child responds on his own. If the child has some comprehension skills, the parent can prompt by saying, "Touch the ______". Ultimately, the child should find sufficient reinforcement from that arranged within the apparatus. Until then, the parent can use social reinforcement by saying 'good' after each correct response or give an edible reinforcer when necessary. The parent can also give social and edible reinforcers at the end of a session. These procedures will vary with each child.

Match-to-Sample II (Letter Discrimination)

Objective: The child, when presented with three (3) windows containing two identical letters and one different letter, will press the two matching windows.

Rationale: This program is included in a sequence of progressively more complex discrimination programs designed to generate reading behavior.

Stimulus Material: The letter matching program contained 48 slides - 24 observing and 24 matching slides. When projected onto the plexiglass windows, the observing slides produce a black

Stimulus Material: (continued) image in the form of a letter on a white background on the top window while the bottom windows are illuminated with white light. The subsequent matching slides produce the same letter in the top window and one of the bottom windows while the second bottom window contains a different letter. Each letter matching program contains three (3) different letters with each of these letters serving as the choice stimulus 8 times. All programs employ a stimulus shaping technique in which the distinctiveness of the mismatch letter is gradually increased. Fading is accomplished by photographing white letters on a black background overlayed with 60 line screen matte acetate shading film (Chartpak) on Kodalith Ortho film. Sixty line matte acetate shading film with the following percentages of area shaded were used: 60%, 50%, 40%, 30%, 20%, and 10%. Letter location was determined quasi-randomly.

Procedure: Same as Match-to-Sample I.

Parental Responsibility: Same as Match-to-Sample I.

Tracking Program

Objective: The child, when presented with three (3) windows, will press the one that is illuminated.

Rationale: The behavior being taught is presumed to be a prerequisite for the Match-to-Sample I program.

Procedure: The program requires the child to touch the window illuminated on a given trial. This closes the microswitch and indicates to the computer a response has been made. A correct response darkens the window and provides reinforcement - the clown eyes flashing for 2 seconds. Window illumination was determined by a quasi-random sequence with the top window illuminated on 50% of the trials.

Parental Responsibility: Parents are given the following instructions for operation of the apparatus. After the phone is placed in the acoustic coupler, the child is placed before the panel. If the the child does not make a response, the adult is to prompt by guiding the hand and gradually fade the prompt as the child responds on his own. If the child has some comprehension skills, the parent can prompt by saying, "Touch the _________". Ultimately, the child should find sufficient reinforcement from that arranged within the apparatus. Until then, the parent can use social reinforcement by saying 'good' after each correct response or give an edible reinforcer when necessary. The parent can also give social and edible reinforcers at the end of the session. These procedures will vary with each child.

Response Devices/Teaching Machines
Constructed for Use on This Project

After a preliminary analysis of the capabilities of the children referred to the project was conducted, three standard devices were constructed. Each is a simple device, designed to meet two criteria: ease of construction and maintenance, and capable of increasing the difficulty or complexity of a response.

Arm Pull

A picture and schematic of the arm pull apparatus are shown in Figures 11 and 12, respectively. The apparatus consists of two vertical braces, 38 cm. high, fastened to a 6 mm. thick plywood base measuring 90 cm. wide by 75 cm. long. Each vertical brace supports a horizontal arm, 30 cm. long, centered in a slot cut in the vertical braces. When the child is placed supine between the vertical braces, two 7.5 cm. pull rings attached to the horizontal arm are adjusted to drop within grasp reach. Variable resistance to the pull rings is provided by springs attached to the horizontal arms. When either arm pivots through a 10° arc, a microswitch closes and activates reinforcement, either 4 seconds of vibration or 10 sec. of taped music.

Kick Panel

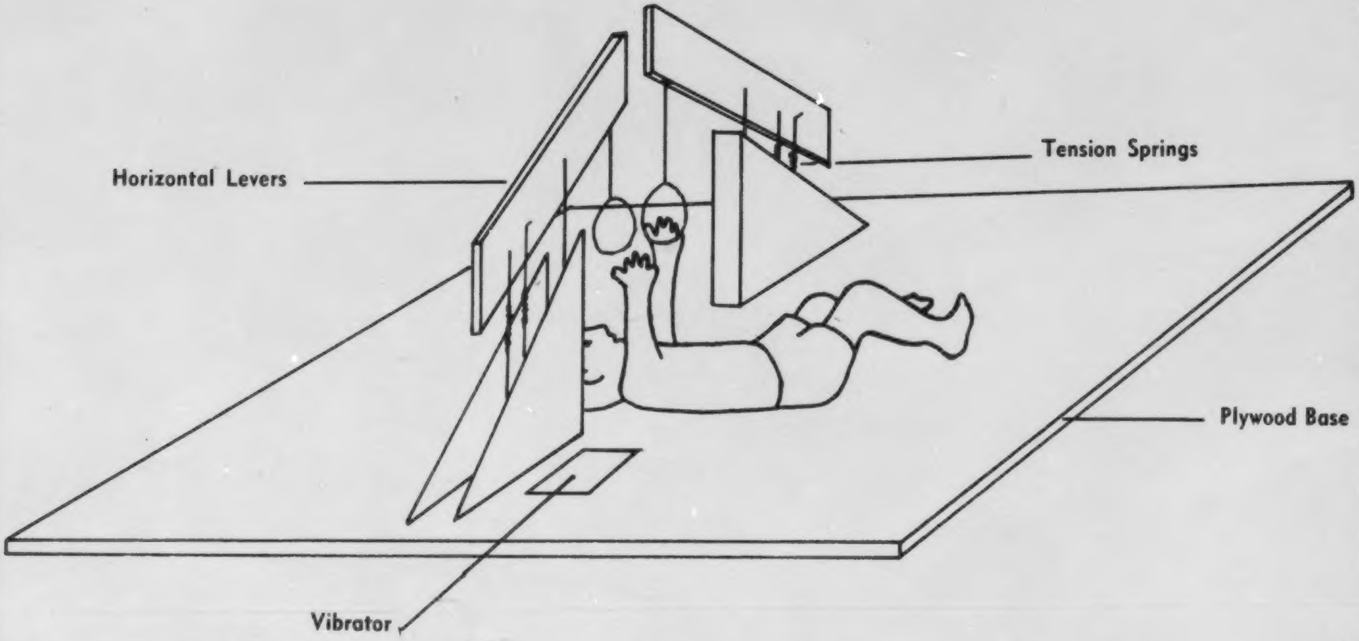
A picture and schematic of the kick panel apparatus appear in Figure 13 and Figure 14, respectively. The kick panel apparatus consists of a 30 cm. wooden square panel supported by a hinge placed 12.7 cm. below the top of a cross braced framework measuring 48 cm. long, 42 cm. wide and 42.7 cm. high. The framework is mounted on a rectangular base 53 cm. long and 76 cm. wide. A microswitch located on the left rear of the framework is closed when the panel swings through a 5° arc and activates reinforcement -- 10 sec. of taped music.

Match-to-Sample

A picture and schematic of the match-to-sample apparatus are shown in Figures 15 and 16, respectively. The match-to-sample apparatus is a wooden box 61.5 cm. long, 49.5 cm. wide, and 33 cm. high, containing three (3) 5 x 5 cm. square plexiglass windows, arranged in the form of a pyramid on the front panel. The top window is centered on the midline 12 cm. from the top and the two bottom windows are centered symmetrically 7 cm. below the top window and 5 cm. on either side of the midline. Located behind each window is a small microswitch which closes contingent upon a response to that window. A rear mounted carousel slide projector presents stimuli on the 3 plexiglass windows. A clown face containing two jewel lights for eyes is mounted on top of the apparatus.

Tracking

A picture and schematic of the tracking apparatus are shown in Figures 15 and 17, respectively. The tracking apparatus is similar to the Match-to-Sample I device with the exception that window illumination is provided by three rear-mounted light bulbs.

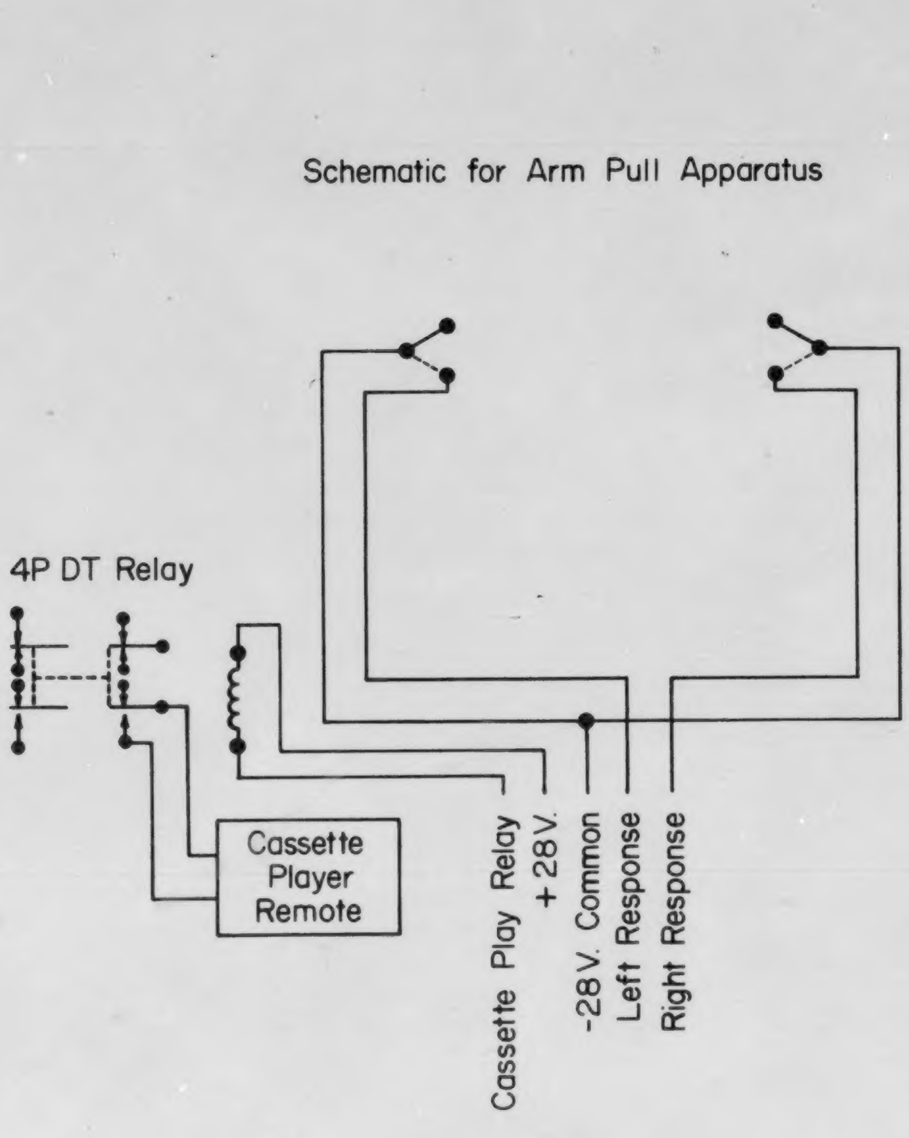


ARM PULL

Reinforcement: tape recorded music

Tension Springs
Horizontal Levers
Plywood Base
Vibrator

FIGURE 11



Schematic for Arm Pull Apparatus

4P DT Relay
Cassette Player Remote
Cassette Play Relay
+ 28 V.
-28 V. Common
Left Response
Right Response

FIGURE 12

KICK PANEL

Reinforcement: tape recorded music

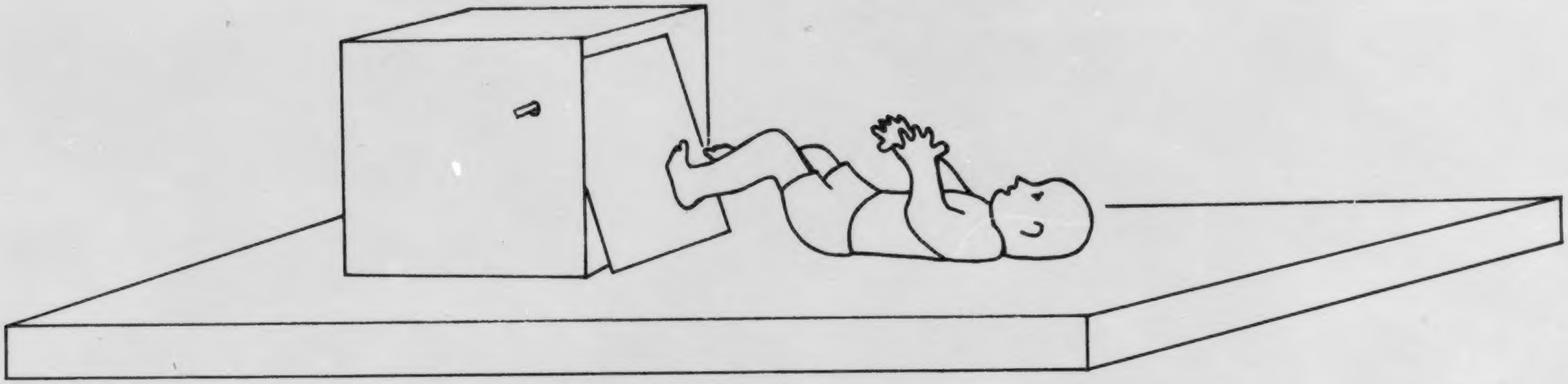


FIGURE 13

Schematic for Kick Panel

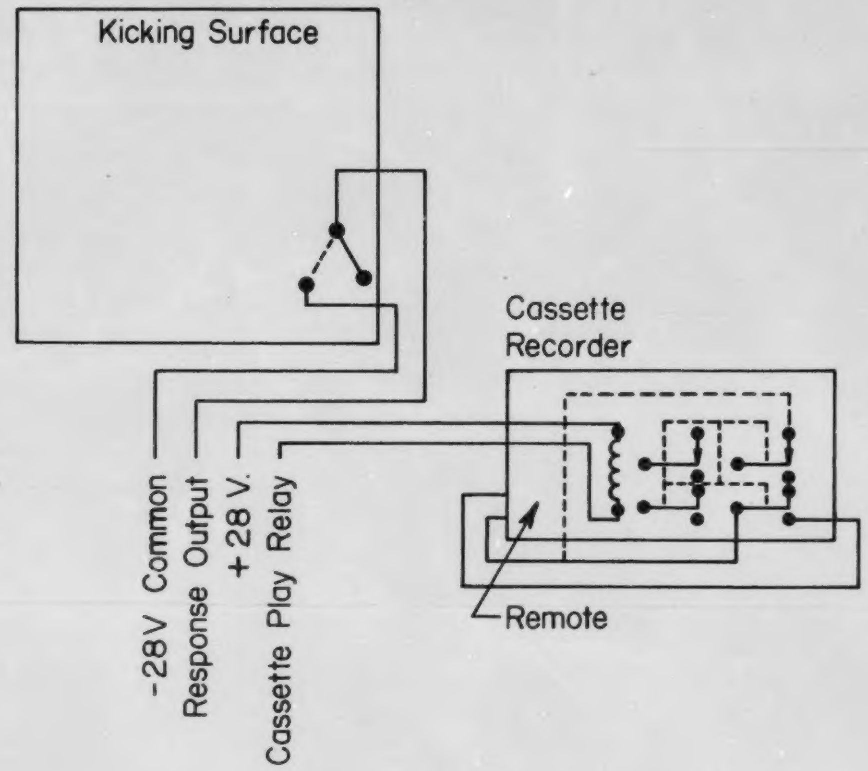
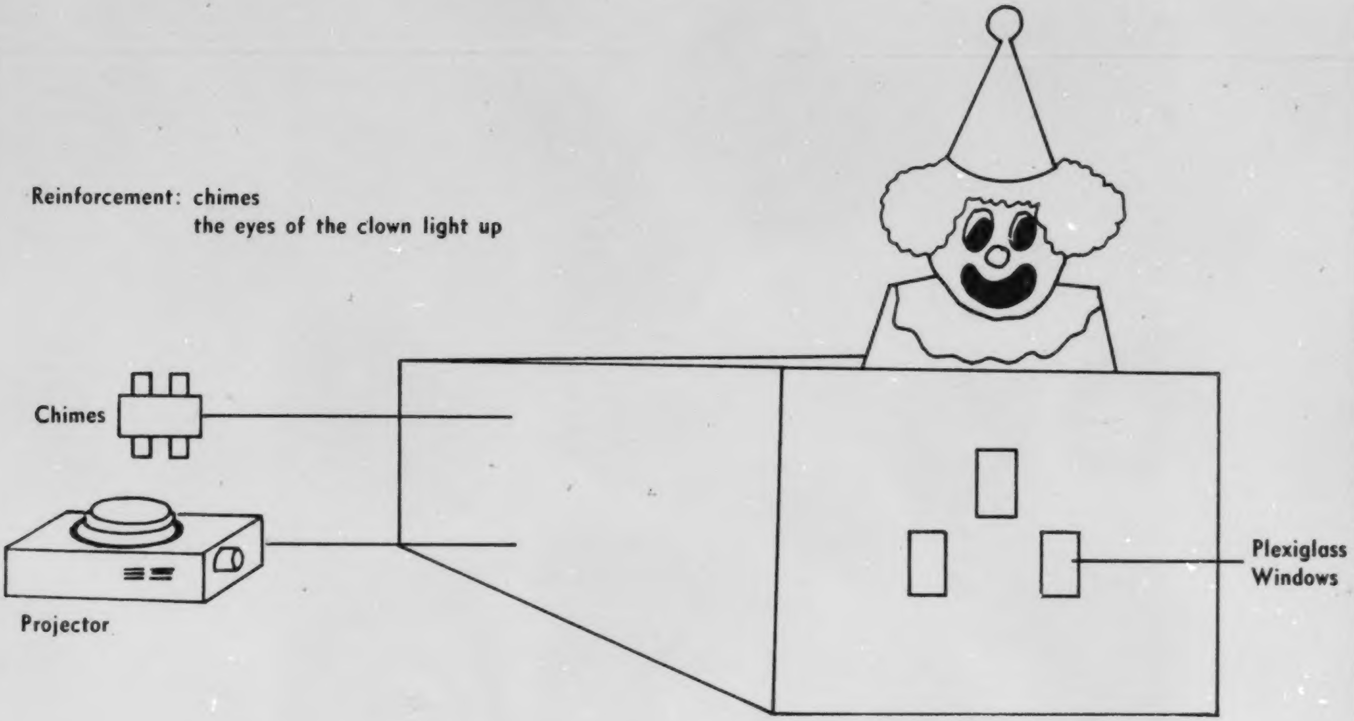

Kicking Surface
Cassette Recorder
Remote
-28V Common
Response Output
+ 28 V.
Cassette Play Relay

FIGURE 14

MATCH-TO-SAMPLE


Chimes
Projector
Plexiglass Windows

Reinforcement: chimes
the eyes of the clown light up

FIGURE 15

Schematic for 3 Window M to S

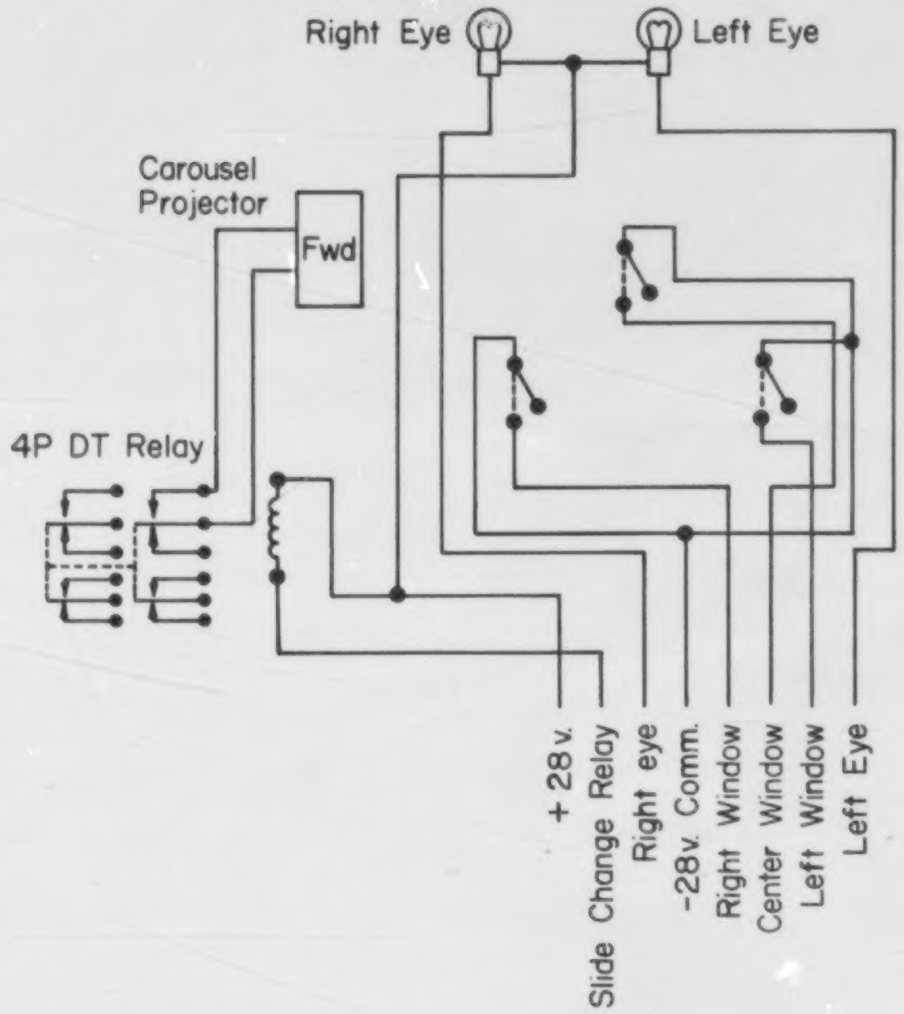

Right Eye
Left Eye
Carousel Projector
Fwd
4P DT Relay
+ 28 v.
Slide Change Relay
Right eye
-28 v. Comm.
Right Window
Center Window
Left Window
Left Eye

FIGURE 16

Schematic for Three Button Tracking Apparatus

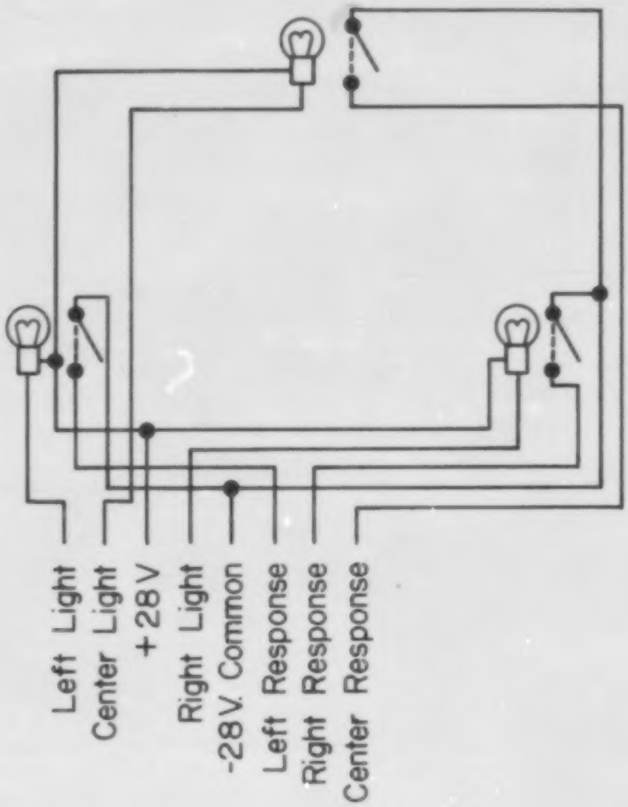

Left Light
Center Light
+ 28 V
Right Light
-28 V. Common
Left Response
Right Response
Center Response

FIGURE 17

This basic configuration can be modified to accommodate a variety of stimulus panel arrangements, e.g. the Sidman panel (any reference to the nine panel matrix, Sidman and Stoddard, 1966) or the Bijou panel (Bijou, 1968). These panels are standard discrimination or concept learning interfaces.

Designing Specific Computer Programs for Each Child

Figure 18 shows the Kick Panel Program after being translated into ACT language for computer programming. When typed on the teletype, a punched paper tape is produced, and simultaneously, the program is stored in the computer memory. When activated for a daily session, children's responses in the home are received through the telephone system within 50 msec. The response is recorded, and a return signal is transmitted within 50 msec.

Activating the Instructional Program

Once the apparatus, acoustic coupler, modem interface, and power supply were placed in the child's home and the computer program stored in memory, only a few simple operations were required to activate the instructional program. Figure 19 shows the sequence of these operations for the Telecommunications Operator (TO) and the parent. First, the TO accessed the appropriate computer station (typed the appropriate station number on the teletype) and called the parent. When the TO had been assured that the parent and child were ready, she instructed the parent to place the home phone in the acoustic coupler and then switched the phone at the Telecommunications center from the vocal to the data transmission mode. After the computer was given a typed command to start the computer program, the parent received a signal indicating he could start the instructional program. The parent pushed a start switch and the instructional program, controlled by the computer program, began. Upon completion of the program, the data from the session was printed out on the teletype and the parent received a signal indicating the instructional program was finished. To assure that the instructional program had run properly, the TO switched back to voice transmission and questioned the parent about the functioning of the apparatus and compared data received with that transmitted, then signed off. This procedure was repeated daily, unless no contact was made.

Parent Intervention/Maintaining Operations Center in the Home

Parent training and regular home visits were included as an integral component of the Telecommunications delivery system. The general objectives were to enable parents to use the instrumentation, to enable them to assist their child, when necessary, to interact with the learning devices, to provide instruction to enable them to teach self-help and other skills not efficiently taught by computer, and to enable them to modify children's behavior when necessary.

The role of the parent trainer was modified significantly. During the first months of the second award period, the parent trainer was involved with the referral and selection process. During the installation phase, the parent trainer accompanied the technology specialists to each home, and assisted with

KICK PANEL PROGRAM TRANSLATED INTO ACT LANGUAGE

```
Station        2
Procedure (001616 Bloc available)
1    SO((H)=0, (HI)=0, (H4)=0)
5    S100
6         A 36 U GØ S200
10   S200
10        A 36 U GØ S100
11   If R200 GØ S0.1
13   S0.1(Print"
Kick Panel/Arm Pull Program   Child "6,"
Start Response given at")
24        A 4 U GØ S0.2
26   S0.2
26        S0.3
27             A 4 U GØ PRØB 1/2 S1
32             A 4 U GØ PRØB 1/2 S0.4
33        S1((H1)=(H1)+1)
34             If (H2) R1 GØ S2
36             A (H3) U GØ S0.4
37        S0.4((H4)=(H4)+1)
40             A (H5) U GØ S0.3
41        S2
41             A (H6) U GØ S0.3
42        A 5 Min GØ S0.5
44   S0.5((H)=(H)+1)
45        A 4 U GØ S0.6
47        For (H)>(H7) GØ S0.7
51   S0.6(Print"
Child "6,"
Min Running (5 min blocks) "5,)
60        A 4 U GØ S0.2
61   S0.7(Print"
Child "6,"
S+ Hits="1,"
S- Hits="2,"
S+ Pres="3,"
S- Pres="4,)
77        A 30 Sec GØ S0
 0        $$

Record
1    In S1:R1 Total C
2    In S0.4:R1 Total C
3    (H1)
4    (H4)
5    (H)
6    (J)
7    $
Command?↑@
```

Master: Station #2
Kick Panel/Arm Pull Program
Function of Program Variables

(H) = cycle count
(H1) = S+ presentation count
(H2) = response requirement
(H3) = S+ length
(H4) = S- presentation count
(H5) = S- length
(H6) = reinforcement length
(H7) = session length (5 min. blocks)
(J) = Sub #

FIGURE 18

SUMMARY OF THE SEQUENCE OF STEPS NECESSARY
FOR PROGRAM OPERATION

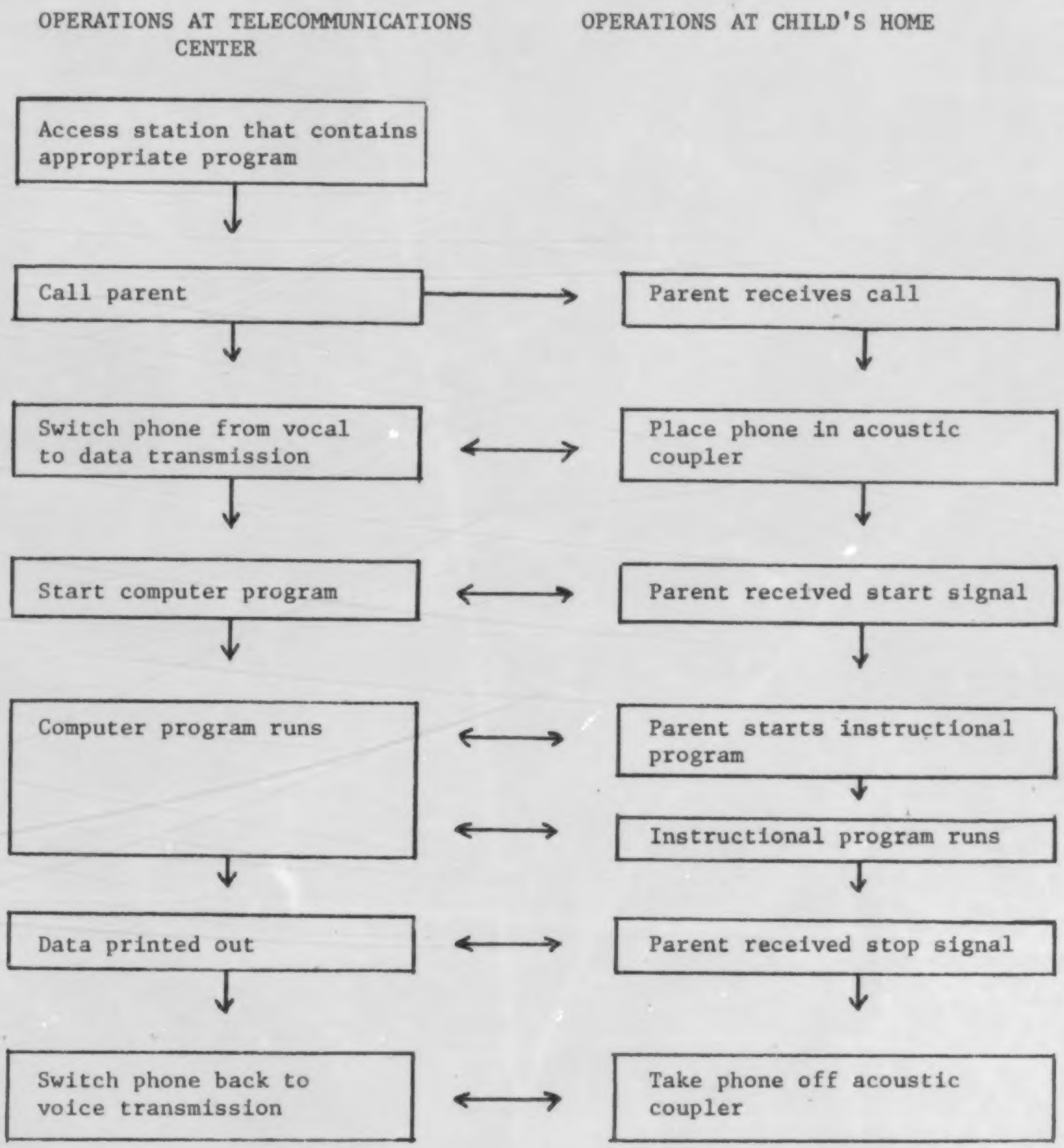

OPERATIONS AT TELECOMMUNICATIONS CENTER
OPERATIONS AT CHILD'S HOME
Access station that contains appropriate program
Call parent
Parent receives call
Switch phone from vocal to data transmission
Place phone in acoustic coupler
Start computer program
Parent received start signal
Computer program runs
Parent starts instructional program
Instructional program runs
Data printed out
Parent received stop signal
Switch phone back to voice transmission
Take phone off acoustic coupler

FIGURE 19

initial training on the apparatus. As noted, the parent trainer observed children during this period, obtained relevant family and child histories, then described the content of the consent forms and obtained written agreement to participate in the project.

After the first installations were activated, the parent trainer travelled extensively to the homes, to assist with the troubleshooting process. The trainer's activities were restricted to observing the apparatus and reporting the nature of malfunctions by telephone to on-site staff, assisting parents to identify and correct minor malfunctions or errors such as improperly positioned switches, etc., and where possible, to complete minor repairs on instrumentation. In other instances, the parent trainer was responsible for disassembling the instrumentation and returning it to the project site for repair. During these visits, when the instrumentation was made operational, the trainer's efforts focused on correct use of the apparatus by parent and child, and on the selection and presentation of reinforcing events.

During the final phase of the project, the parent trainer was responsible for assisting with arrangements for comprehensive medical examinations at the University's Center for the Handicapped.

SECTION SIX

OUTCOMES OF FAMILY INFORMATION GATHERING AND CHILD INTERVENTION ACTIVITIES

Format

This section contains demographic information on the family, educationally relevant medical histories on the child, a description of the social and physical environment, a list of the child's entering behaviors as observed during initial interviews, and a graph and description of child performance on the selected instructional programs. This information is arranged in case history report form, in order to provide critical information about the child and the environment, along with the results of the instructional intervention.

Each graph contains the name of the instructional program. The descriptions of the apparatus are found in Section Three and the instructional programs are found in Section Five. Each instructional session for each child is shown as either the number of responses per session for free operant activities, or as the percent of correct responses on discrete learning trials.

CASE HISTORY

Identification Code:
I-3-z

Location Code:
I-3

Date of Birth:
10/16/73

Parent Information:
Father's age: 44 years
education: eighth grade
occupation bus driver for a federal program
Mother's age: 38 years
education: eighth grade
occupation: housewife
Siblings: 8
Primary caretaker: Mother and two teenaged sisters
Persons in home during day: Mother, two teenaged divorced sisters, two preschoolers, children of one sister.

Medical/Social Data:

I-3-z is a two and one half (2 1/2) year old female with Down's Syndrome, congenital heart defect and congenital cataracts.

The family of 12 persons receives services from a variety of agencies, including SSI benefits for the two handicapped children in the home, food stamps, aid to dependent children for one divorced sister's two preschool children, and the regional Comprehensive Care Center.

Physical Environment:

a) The home is located in I-3, a small town in a coal mining region in the south central part of the state.

b) Description of the home: This is a three (3) room frame home with outdoor facilities.

c) Location of the Learning Apparatus: The learning apparatus is located in the large front room that serves as a bedroom/living room.

Entering Behaviors:

Language:	a)	had limited production of single speech sounds
	b)	cried
	c)	had low rate of vocal production
Motor:	a)	had no head control
	b)	eyes followed moving object
	c)	had inconsistent grasp response
Social:	a)	smiled
	b)	reached for father
	c)	seemed to recognize mother and father (smiled at their voices)
Cognitive:	a)	eyes followed light
	b)	was beginning to "bat" at objects
Self-help:	a)	drank from a held or propped bottle

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	6	=	36	
occupation	9	x	7	=	63	
education	5	x	6	=	30	
score of Index on social position					129	= V

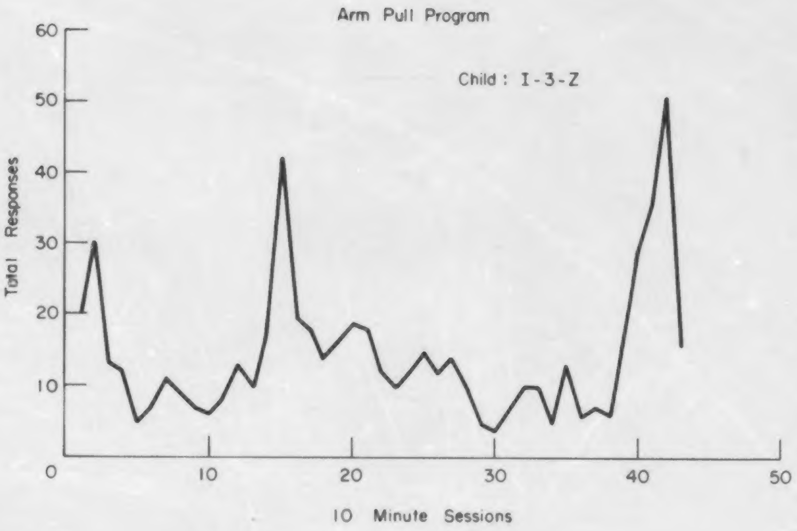


FIGURE 20

Figure 20 shows the results of child I-3-z on the Arm Pull apparatus. Staff evaluation indicated that child I-3-z was developmentally delayed on independent sitting behavior. As well as being an important behavior in its own right, independent sitting is a prerequisite for interaction with the Match-to-Sample apparatus. With the exception of 3 peaks at the beginning, middle, and end of the program, child I-3-z's performance remained at about 15 responses per session.

CASE HISTORY

Identification Code:
I-6-w

Location Code:
I-6

Date of Birth:
4/26/74

Parent Information:
Father's age: 29 years
education: M.A. degree
occupation: teacher
Mother's age: 32 years
education: M.A. degree
occupation: teacher
Siblings: none
Primary Caretaker: sitter/parents
Persons in home during day: baby sitter

Medical/Social Data:

I-6-w is a two (2) year old Down's Syndrome female. Records indicate heart catheterization was done at sixteen (16) months of age and open heart surgery was done at twenty-six (26) months of age.

Physical Environment:

a) The home is located in I-6, a small rural community in the northeast area of the state.
b) Description of the home: The home is a six (6) room brick house.
c) Location of the Learning Apparatus: The learning apparatus is located in the child's bedroom.

Entering Behaviors:

Language:	a) babbled
	b) laughed
	c) cried
Motor:	a) grasped objects
	b) sat alone if put in position
	c) rolled over
Social:	a) demanded attention
	b) was aware of strangers
	c) imitated pat-a-cake
Cognitive:	a) put objects into mouth
	b) had pincer grasp
Self-help:	a) ate mashed table food fed by parent
	b) drank from cup with help
	c) was beginning to finger feed

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score		Class
residence	6	x	4	=	24		
occupation	9	x	2	=	18		
education	5	x	1	=	5		
score of Index on social position					47	=	II

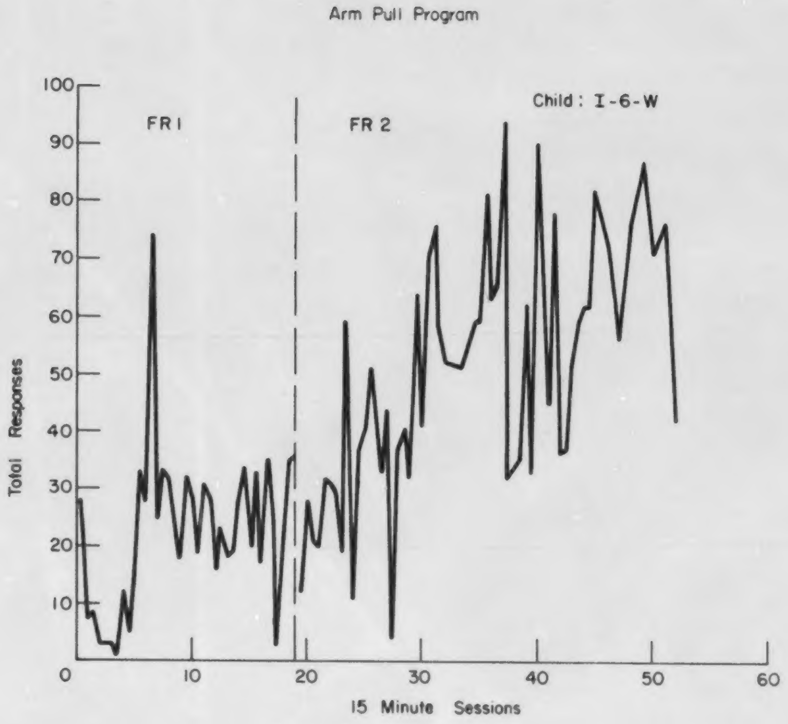


FIGURE 21

Figure 21 shows the results of child I-6-w on the Arm Pull apparatus. Staff evaluation indicated that child I-6-w was developmentally delayed on independent sitting behavior. As well as being an important behavior in its own right, independent sitting is a prerequisite for interaction with the Match-to-Sample apparatus. The data show that after some initial variability, performance leveled off to about 25 responses per session from sessions 7-19. There was a slight decrement in responding after introduction of the Fixed Ratio 2 (FR2) schedule of reinforcement on session 20, followed by a gradual increase to over 50 responses per session.

CASE HISTORY

Identification Code:
I-9-t

Location Code:
I-9

Date of Birth:
6/4/71

Parent Information:
Father's age: 37 years
education: sixth grade
occupation: self-employed
Mother's age: 33 years
education: high school
occupation: housewife
Siblings: 2 brothers, 10 and 3 years
Primary Caretaker: Mother
Persons in home during day: Mother and younger brother

Medical/Social Data:

I-9-t is a five (5) year old male with a developmental defect of unknown type and hyperactivity. The family receives benefits from social service agencies, including SSI and the regional Comprehensive Care Center.

Physical Environment:

a) The home is located in I-9, a small coal mining community in the northeastern part of the state.

b) Description of the home: The home is a four (4) room frame house.

c) Location of Learning Apparatus: The learning apparatus is located in the living room.

Entering Behaviors:

Language:	a)	had two (2) single understandable words: no, ma
	b)	verbal production was mainly gibberish
	c)	had low rate of vocal production
Motor:	a)	walked unassisted
	b)	had some manipulation of objects
	c)	walked downstairs, one step at a time
Social:	a)	acted to gain adult attention
	b)	had some appropriate play with younger brother
	c)	followed some simple directions
Cognitive:	a)	had pincer grasp
	b)	scribbled on paper
	c)	identified some body parts with help
Self-help:	a)	fed self with fingers
	b)	was beginning to use spoon
	c)	occasionally indicated bathroom needs

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	5	=	30	
occupation	9	x	7	=	63	
education	5	x	7	=	35	
score on Index of social position					128	= V

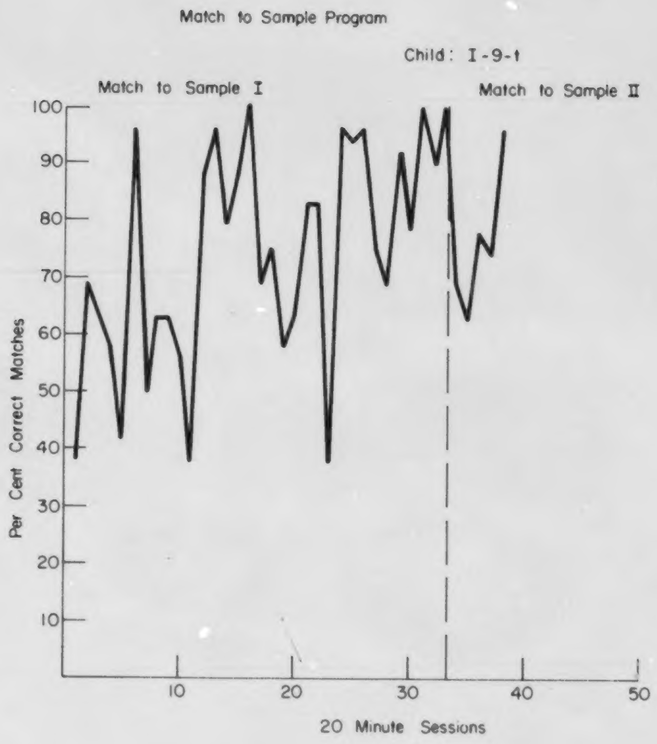


FIGURE 22

Figure 22 shows the results of child I-9-t on the Match-to-Sample apparatus. The staff felt that child I-9-t met the prerequisites for the Match-to-Sample program; therefore, he was placed directly on the brightness matching program. Sessions 1-33 of Figure 22 show the performance of child I-9-t on the Match-to-Sample I program. The child's inconsistent performance is reflected in the variability of the data. Nevertheless, performance did stabilize somewhat over 5 sessions, during which the percent correct matches did not fall below 79%. There is very little data for child I-9-t on the letter matching program as his program was interrupted by a kidney operation. However, after an initial decrement, his performance improved to 96% correct matches.

CASE HISTORY

Identification Code:
I-12-q

Location Code:
I-12

Date of Birth:
2/4/74

Parent Information:
Father's age: 28 years
education: high school
occupation: unemployed
Mother's age: 32 years
education: eighth grade
occupation: housewife
Siblings: 2 older, fourth child expected in November, 1976.
Primary Caretaker: Mother
Persons in home during day: Mother & 4 year old brother

Medical/Social Data:

I-12-q is a two (2) year old male diagnosed as developmentally delayed (unknown etiology) and failure to thrive. Telecommunications Project tried to have a telephone installed in the home from November, 1975 to June, 1976 without success. The family receives benefits from many social service agencies, including SSI, food stamps and welfare.

Physical Environment:

a) The home is located in I-12, a small mining community in the northeastern part of the state.

b) Description of the home: The home is a five (5) room mobile home.

c) Location of the Learning Apparatus: None as yet.

Entering Behaviors:

Language:	a)	had little vocal production
	b)	cried
	c)	laughed
Motor:	a)	sat alone for a few seconds
	b)	was beginning to grab at objects
Social:	a)	smiled at adult attention
	b)	cried at removal of adult attention
Cognitive:	a)	eyes followed moving object
	b)	seemed to know mother
	c)	recognized strangers
Self-help:	a)	drank from a held bottle
	b)	ate strained food fed by parent

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	5	=	30	
occupation	9	x	7	=	63	
education	5	x	4	=	20	
score of Index on social position					113	= IV

CASE HISTORY

Identification Code:
I-13-p

Location Code:
I-13

Date of Birth:
8/23/72

Parent Information:
Father's age: 25 years
    education: fifth grade
    occupation: coal miner
Mother's age: 21 years
    education: tenth grade
    occupation: housewife
Siblings: brother, 5 years old
    third child due 6/76
Primary Caretaker: Mother
Persons in home during day: Mother & brother

Medical/Social Data:

I-13-p is a three and one half (3 1/2) year old male, who was, at 3.5 months of age, diagnosed at the end of a nineteen (19) day hospital stay, as suffering from hypotonic dehydration resulting in brain damage and seizures. Records further indicate that at that time child welfare workers were notified of the probability of child neglect. Records also indicate that the family was followed by Home Health Services for a period of time after this referral. Telecommunications Project installed a telephone in this home.

Physical Environment:

a) The home is located in I-13, a small mining village in the south-eastern part of the state.

b) Description of the home: The home is a five (5) room mobile home.

c) Location of the Learning Apparatus: The learning apparatus is located in the living room.

Entering Behaviors:

Language:	a)	produced no speech sounds
	b)	cried
	c)	laughed
Motor:	a)	limited movements of arms and legs
	b)	had no head control
	c)	hands were fisted at all times
Social:	a)	smiled and laughed in response to adult attention
	b)	cried at removal of adult attention
Cognitive:	a)	seemed to recognize mother
	b)	eyes followed moving person
Self-help:	a)	opened mouth for food
	b)	drank from held bottle

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	5	=	30	

Socioeconomic Status Scale continued:

factors	factor weight	x	scale value	=	partial score	Class
occupation	9	x	6	=	54	
education	5	x	7	=	35	
score of Index on social position					119	= V

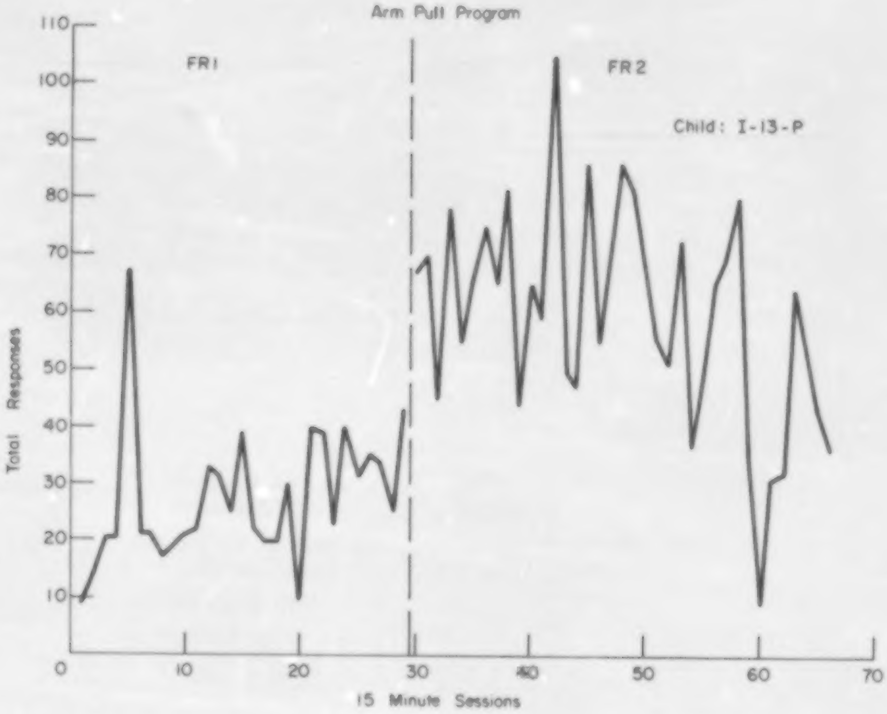


FIGURE 23

Figure 23 shows the results of child I-13-p on the Arm Pull apparatus. Staff evaluation indicated that child I-13-p was developmentally delayed on independent sitting behavior. As well as being an important behavior in its own right, independent sitting is a prerequisite for interaction with the Match-to-Sample apparatus. For the first 29 sessions child I-13-p showed a steady increase in responding from 9 to about 35 total responses per session. Responding increased immediately on session 30 with the introduction of the Fixed Ratio 2 (FR2) reinforcement schedule. The FR2 schedule maintained responding at about 65 responses per session until session 59 when responding decreased for four sessions followed by an increase and a second performance decrement.

CASE HISTORY

Identification Code:
I-15-m

Location Code:
I-15

Date of Birth:
4/4/69

Parent Information:
Father: unknown
Mother's age: 22 years
education: sixth grade plus attended Regional Rehabilitation Center for training as nurse's aide
occupation: unemployed
Siblings: none
Primary Caretaker: Mother
Persons in home during day: Mother

Medical/Social Data:

I-15-m is a seven (7) year old male with cerebral palsy and moderate spastic quadraparesis. I-15-m was the product of a pregnancy with no prenatal supervision. Neonatal course was complicated by an RH incompatibility.

The child and his mother receive services from a variety of social service agencies, including aid to dependent children, food stamps, public housing and the regional Comprehensive Care Center which referred the child to this project.

Physical Environment:

a) The home is located in I-15, a small coal mining town, in the southeastern part of the state.

b) Description of the home: The home is a four (4) room apartment in the public housing facility. Telecommunications Project installed a telephone for this family.

c) Location of Learning Apparatus: The learning apparatus is located in the living room.

Entering Behaviors:

Language:	a)	had limited production of single words: ma, bye
	b)	cried
	c)	grunted
Motor:	a)	walked seven (7) or eight (8) steps without aid, gait very unsteady
	b)	seated self in small chair
	c)	rolled ball without prompt
Social:	a)	waved bye-bye
	b)	acted to gain attention
	c)	had some appropriate play with toys
Cognitive:	a)	could reach, grasp and put object in mouth (pre-pincer grasp)
	b)	dropped and picked up toy
	c)	placed rings on peg in no order
	d)	scribbled on paper
Self-help:	a)	fed self with fingers
	b)	held cup
	c)	was beginning to use spoon

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	5	=	30	
occupation	9	x	7	=	63	
education	5	x	7	=	35	
score of Index on social position					128	= V

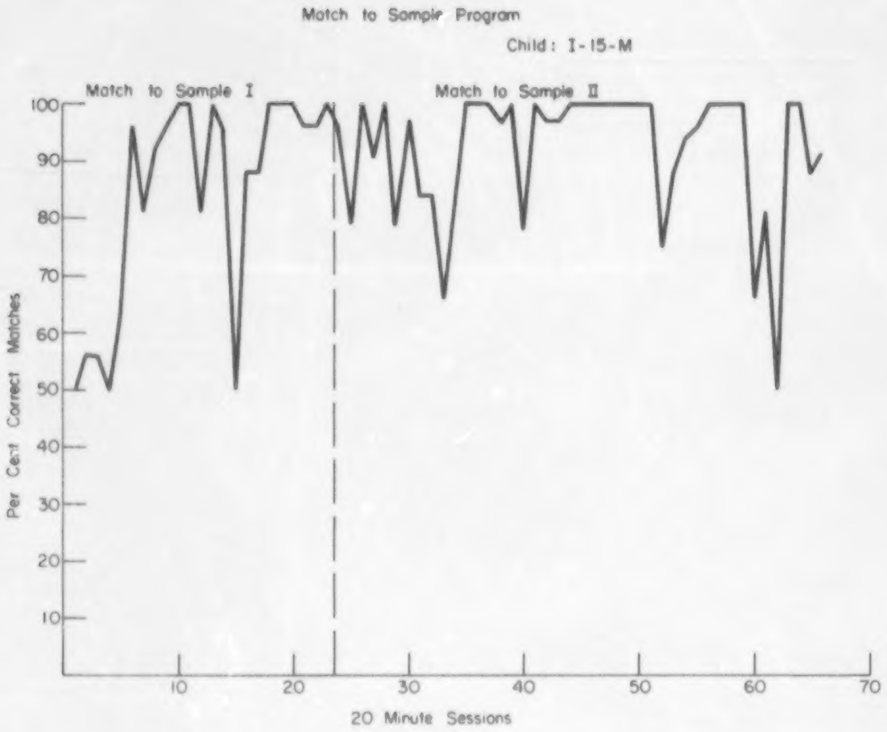


FIGURE 24

Figure 24 shows the results of child I-15-m on the Match-to-Sample apparatus. The staff felt that child I-15-m met the prerequisite for the Match-to-Sample program; therefore, he was placed directly on the brightness matching program. The first 23 sessions of Figure 24 show the performance of child I-15-m on the Match-to-Sample I program. After the first five sessions and excluding session 15, child I-15-m matched correctly on better than 80% of the trials. On session 24 the Match-to-Sample II program was initiated with very little decrement in performance.

CASE HISTORY

Identification Code:
I-16-1

Location Code:
I-16

Date of Birth:
7/21/72

Parent Information:
Father's age: 37 years
education: eighth grade
occupation: previous work in upholstery, presently lay preacher
Mother's age: 26 years
education: sixth grade
occupation: housewife
Siblings: four half siblings from father's previous marriage, currently living out of state -- two half siblings from mother's previous marriage who were removed from this home in 1975 and placed in foster care.
Primary caretaker: Parents
Persons in home during day: Parents

Medical/Social Data:

I-16-1 is a three and one half (3 1/2) year old male, who was diagnosed at the age of eleven (11) months as microcephalic and epileptic. He was delivered by the father in a truck on the way to the regional clinic, after a full term, uneventful pregnancy. The umbilical cord was not cut until the family reached the clinic, with the infant turning "black" after the cord was severed.

Records indicate that the mother seems to be functioning on a low educable level. This family receives benefits from several social service agencies, including food stamps, SSI, and the regional Comprehensive Care Center which referred the child to this project.

Physical Environment:

a) The home is located in I-16, a small coal mining village in the southeastern part of the state.

b) Description of the home: The home is a frame three (3) room dwelling with outdoor facilities.

c) Location of the Learning Apparatus: The learning apparatus is located in the bedroom, which the child shares with his parents.

Entering Behaviors:

Language: a) had no production of vocal sounds
b) cried
c) laughed
Motor: a) had limited movement of arms and legs

b) had no head control
c) hands held fisted at all times

Social: a) smiled and laughed when stimulated by adult
b) cried at removal of adult attention

Cognitive: a) eyes followed moving person
b) responded (smiled) to parents' voices

Self-help: a) opened mouth for food

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	6	=	36	
occupation	9	x	7	=	63	
education	5	x	6	=	30	
score of Index on social position					129	= V

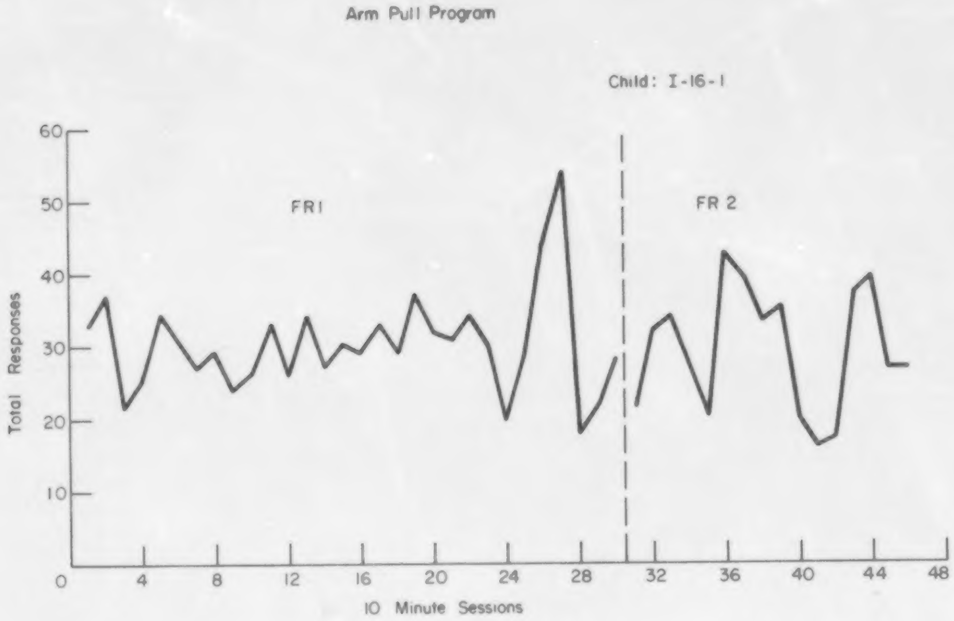


FIGURE 25

Figure 25 shows the results of child I-16-1 on the Arm Pull apparatus. Staff evaluation indicated that child I-16-1 was developmentally delayed on independent sitting behavior. As well as being an important behavior in its own right, independent sitting is a prerequisite for interaction with the Match-to-Sample apparatus. The first 30 sessions of Figure 25 show that child I-16-1 maintained a relatively stable rate of responding of about 30 responses per session. The change in reinforcement schedule to a Fixed Ratio 2 (FR2) on session 31 appeared to have little effect on response rate.

CASE HISTORY

Identification Code:
II-8-u

Location Code:
II-8

Date of Birth:
12/22/73

Parent Information:
Father's age: 31 years
education: high school
occupation: machine operator in factory, works in theater at night
Mother's age: 24 years
education: ninth grade
occupation: housewife
Siblings: brother, 7 years
Primary Caretaker: Mother, uncle
Persons in home during day: Mother, uncle

Medical/Social Data:

II-8-u is a two and one half (2 1/2) year old female who was diagnosed at nine (9) months of age as microcephalic with psychomotor retardation. However, on 3/6/75, a thorough genetic evaluation was done at a university hospital, the earlier diagnosis was rejected and the presence of Cornelia de Lange Syndrome was noted.

II-8-u resides with her parents, older brother and adult maternal uncle.

Physical Environment:

a) The home is located in II-8, about 87 miles from a small industrial area in the southwest part of the state.

b) Description of the home: The home is a five (5) room brick ranch-style house with attached carport.

c) Location of the Learning Apparatus: The learning apparatus is located in the bedroom the child shares with her parents.

Entering Behaviors:

Language:	a)	produced no vocal speech sounds
	b)	cried
Motor:	a)	turned from stomach to back
	b)	was beginning to grasp
Social:	a)	smiled in response to adult attention
	b)	cried at removal of adult attention
Cognitive:	a)	smiled at the sound of mother's voice
	b)	eyes followed moving person
Self-help:	a)	opened mouth at sight of bottle

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score		Class
residence	6	x	4	=	24		
occupation	9	x	6	=	54		
education	5	x	4	=	20		
score of Index on social position					98	=	IV

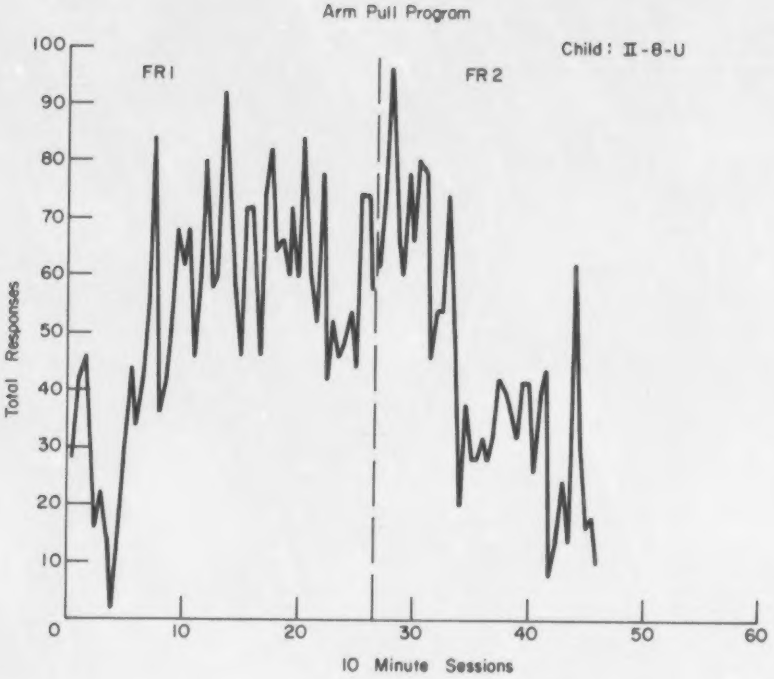


FIGURE 26

Figure 26 shows the results of child II-8-u on the Arm Pull apparatus. Staff evaluation indicated that child II-8-u was developmentally delayed on independent sitting behavior. As well as being an important behavior in its own right, independent sitting is a prerequisite for interaction with the Match-to-Sample apparatus. Figure 26 reveals that child II-8-u's performance was inconsistent from session to session. However, three general trends seem to emerge: 1) a relatively low level of responding in the early session followed by 2) an increase and stabilization in performance and 3) terminating in a performance decrement. The introduction of the Fixed Ratio 2 (FR2) reinforcement schedule appeared to have no immediate effect.

CASE HISTORY

Identification Code:
II-17-k

Location Code:
II-17

Date of Birth:
10/24/73

Parent Information:
Father's age: 29 years
education: twelfth grade
occupation: factory worker
Mother's age: 25 years
education: GED
occupation: housewife
Siblings: sister, 9 years
Primary Caretaker: Mother
Persons in home during day: Mother

Medical/Social Data:

II-17-k is a two and one half (2 1/2) year old female diagnosed as displaying early Cockayne Syndrome. Records indicate she was the product of a seven (7) month gestation with low birthweight. The family did receive a variety of social service benefits during a period of the father's unemployment (which lasted for one year). These benefits included SSI and food stamps. The family no longer receives these benefits.

Physical Environment:

a) The home is located in II-17, an industrial town in the northwestern part of the state.

b) Description of the home: The home is a five (5) room frame house.

c) Location of the Learning Apparatus: The learning apparatus is located in the child's bedroom.

Entering Behaviors:

Language:	a)	had little vocal production
	b)	grunted
	c)	cried
Motor:	a)	turned from stomach to back
	b)	"batted" at objects
	c)	was beginning to grasp objects
Social:	a)	smiled at adult attention
	b)	cried at removal of adult attention
Cognitive:	a)	smiled at the sound of parents' voices
	b)	eyes followed moving object
Self-help:	a)	opened mouth for food

Socioeconomic Status Scale:

factor	factor weight	x	scale value	=	partial score		Class
residence	6	x	4	=	24		
occupation	9	x	7	=	63		
education	5	x	4	=	20		
score on Index of social position					107	=	IV

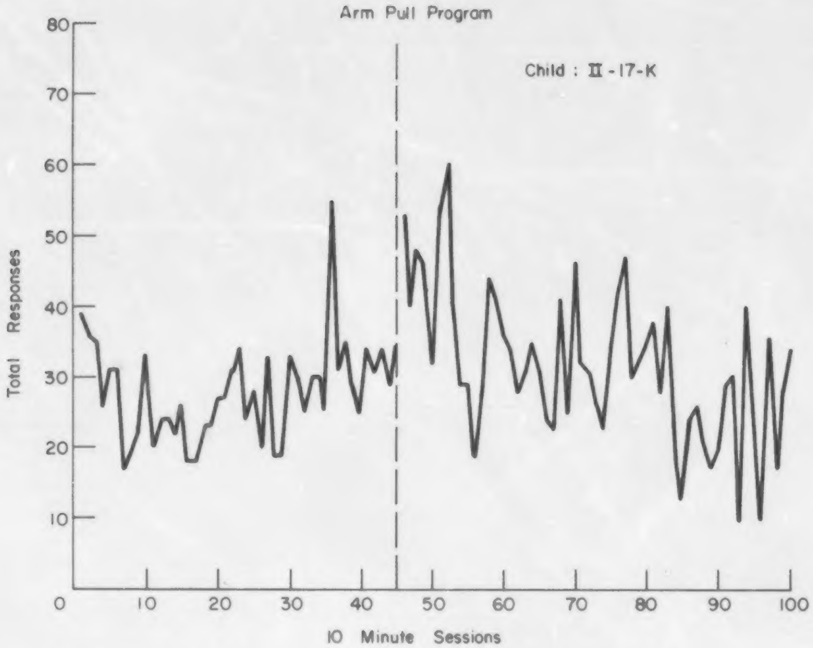


FIGURE 27

Figure 27 shows the results of child II-17-k on the Arm Pull apparatus. Staff evaluation indicated that child II-17-k was developmentally delayed on independent sitting behavior. As well as being an important behavior in its own right, independent sitting is a prerequisite for interaction with the Match-to-Sample apparatus. The first 45 sessions of Figure 27 show that child II-17-k responded at a relatively stable rate of about 30 responses per session. With the introduction of the Fixed Ratio 2 (FR2) reinforcement schedule, performance increased to about 50 responses per session over the first 7 days of program change. Following this increase, the number of responses emitted decreased to about 35-40 responses per session for 34 sessions before again falling off to the rate emitted prior to the introduction of FR2 reinforcement schedule.

CASE HISTORY

Identification Code:
II-20-f

Location Code:
II-20

Date of Birth:
9/3/72

Parent Information:
Father's age: 35 years
education: B.S. degree
occupation: Manager of a business
Mother's age: 32 years
education: high school
occupation: housewife
Siblings: brother, 8 years
Primary Caretaker: Mother
Persons in home during day: Mother

Medical/Social Data:

II-20-f is a three and one half (3 1/2) year old male with cerebral palsy.

The child receives speech therapy from the local Comprehensive Care Center who referred the child to this project.

Physical Environment:

a) The home is located in II-20, a small farming community in the western part of the state.

b) Description of the home: The home is a six (6) room brick ranch-style house.

c) Location of the Learning Apparatus: The learning apparatus is located in the child's bedroom.

Entering Behaviors:

Language:	a)	followed some simple commands
	b)	had no intelligible words
	c)	produced beginning consonant sounds only
Motor:	a)	walked, unsteady, awkward gait
	b)	fell frequently
	c)	could manipulate some objects
Social:	a)	smiled and acted for adult attention
	b)	had some play with toys
	c)	was beginning to imitate
Cognitive:	a)	could point to some named body parts
	b)	could match few colors with help
Self-help:	a)	could feed self with spoon
	b)	could use cup

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score		Class
residence	6	x	3	=	18		
occupation	9	x	3	=	27		
education	5	x	2	=	10		
score of Index on social position					55	=	II

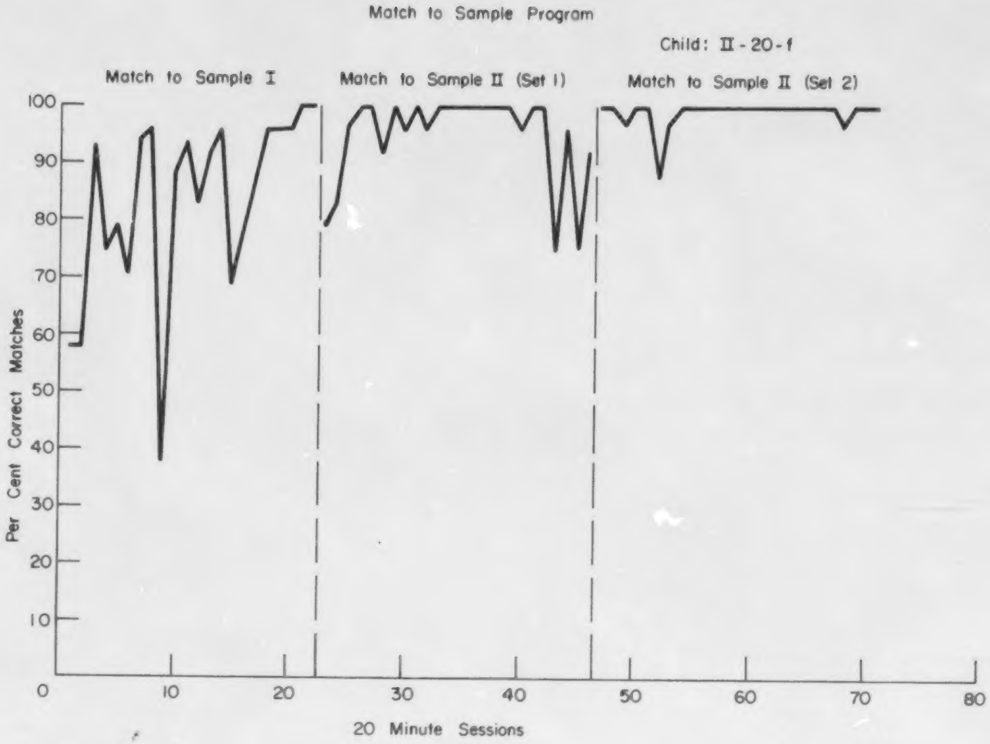


FIGURE 28

Figure 28 shows the results of child II-20-f on the Match-to-Sample I and II programs. The staff felt that child II-20-f met the prerequisites for the Match-to-Sample program; therefore, he was placed directly on the brightness matching program. With the exception of sharp drops in performance on sessions 9 and 25, the data reflect a gradual increase in correct matches across sessions during the Match-to-Sample I program. The introduction of the Match-to-Sample II program resulted in an initial reduction in correct matches. However, performance returned and remained at a high level after only two days of exposure to this program. Immediately prior to the introduction of a new set of letters, the data show a drop in performance. However, with the presentation of the new letter set, performance was returned to 90% or more correct matches.

CASE HISTORY

Identification Code:
II-46-af

Location Code:
II-46

Date of Birth:
9/6/74

Parent Information:
Father: unknown
Mother's age: 15 years, no other information
Siblings: none
Primary Caretaker: foster mother
Persons in home during day: foster mother, foster sister

Medical/Social Data:

II-46-af is a one and one half (1 1/2) year old female, noted at birth to be microcephalic. II-46-af is the child of a fifteen (15) year old unwed mother. She was born in a home for unwed mothers and was not recommended for adoption. II-46-af was placed in her current foster home at the age of one (1) month. II-46-af receives SSI benefits.

Physical Environment:

a) The foster home is located in a small farming community in the southwestern part of the state.

b) Description of the home: The home is a seven (7) room brick house.

c) Location of the Learning Apparatus: The learning apparatus is located in the living room.

Entering Behaviors:

Language:	a)	produced few vocal sounds
	b)	cried
Motor:	a)	turned from stomach to back
	b)	grasped objects
Social:	a)	smiled at adult attention
	b)	cried at removal of adult attention
Cognitive:	a)	was beginning to imitate pat-a-cake
	b)	recognized strangers
Self-help:	a)	helped hold own bottle
	b)	opened mouth for food fed by adult

Socioeconomic Status Scale:

None because of placement in foster home.

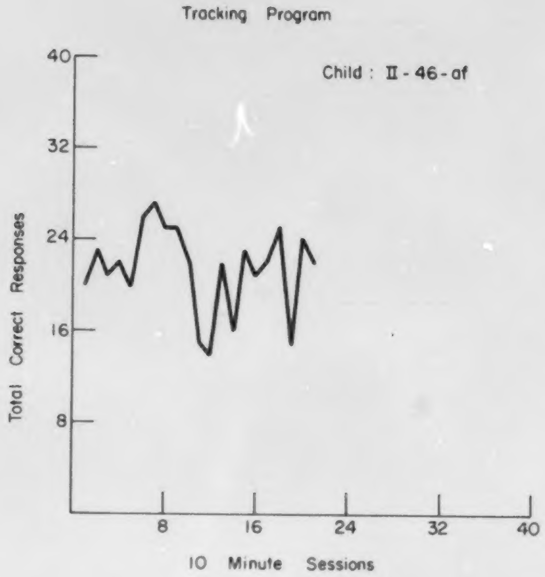


FIGURE 29

Figure 29 shows the results of child II-46-af on the Tracking apparatus. Child II-46-af displayed independent sitting behavior, but staff evaluation indicated that attending behavior would preclude beneficial interaction with the Match-to-Sample programs. Consequently, child II-46-af was placed on the Tracking program. The data reveal that there was little improvement in performance over the 21 sessions the child was on the program; total correct responses remained at about 20 responses per session.

CASE HISTORY

Identification Code:
II-47-ag

Location Code:
II-47

Date of Birth:
2/19/75

Parent Information:
Father's age: 37 years
education: 1 year of college
occupation: self-employed
Mother's age: 35 years
education: tenth grade
occupation: factory worker
Siblings: two from father's previous marriage, one from mother's previous marriage, no other children in home.
Primary Caretaker: Parents
Persons in home during day: Father

Medical/Social Data:

II-47-ag is a sixteen (16) month old male, diagnosed as having characteristics of Down's Syndrome. Records indicate he was premature and possibly has a congenital heart defect.

Physical Environment:

a) The home is located in II-47, a small farming community in the west central part of the state.

b) Description of the home: The home is a five (5) room mobile home with a two (2) room addition on the back.

c) Location of the Learning Apparatus: The learning apparatus is located in the living room.

Entering Behaviors:

Language:	a)	babbled
	b)	cried
	c)	laughed
Motor:	a)	sat only with support
	b)	grasped objects
	c)	moved about in walker
Social:	a)	cried at removal of adult attention
	b)	laughed and cooed at adult attention
	c)	acted to gain adult attention
Cognitive:	a)	eyes followed moving person
	b)	reached, grabbed and put objects in mouth
Self-help:	a)	was beginning to drink from cup with help
	b)	was finger feeding

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	4	=	24	
occupation	9	x	6	=	54	
education	5	x	3	=	15	
score of Index on social position					93	= IV

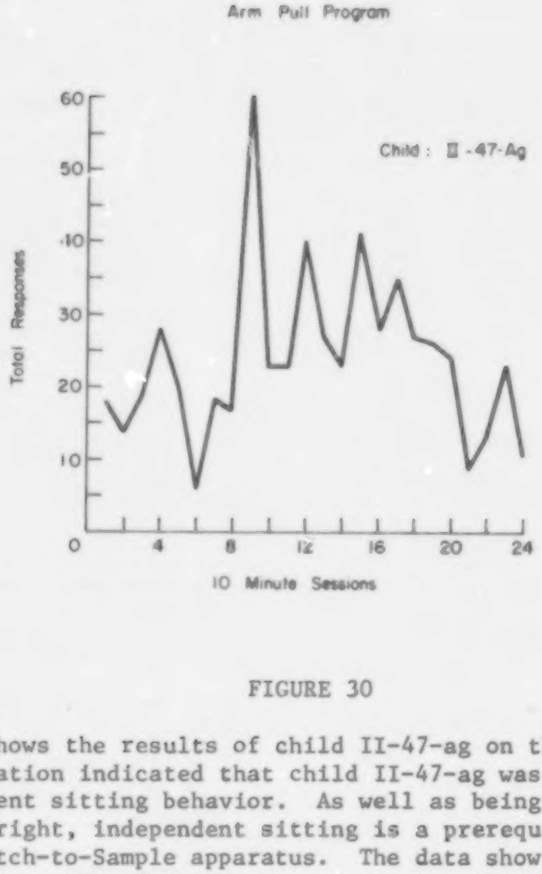


FIGURE 30

Figure 30 shows the results of child II-47-ag on the Arm Pull apparatus. Staff evaluation indicated that child II-47-ag was developmentally delayed on independent sitting behavior. As well as being an important behavior in its own right, independent sitting is a prerequisite for interaction with the Match-to-Sample apparatus. The data show that the child emitted the greatest number of responses per session during the middle sessions with performance dropping to lower levels at the beginning and end of the program.

CASE HISTORY

Identification Code:
III-2-aa

Location Code:
III-2

Date of Birth:
11/14/73

Parent Information:
Father's age: 37 years
education: eleventh grade
occupation: locksmith helper
Mother's age: 31 years
education: ninth grade
occupation: currently on sick leave from waitress job
Siblings: no information on father's previous marriage. 4 half siblings from mother's previous marriage, living out of home. 4 year old sister in home.
Primary Caretaker: Mother
Persons in home during day: Mother

Medical/Social Data:

III-2-aa is a two and one half (2 1/2) year old Down's Syndrome female who was the product of a seven month gestation. The parents are divorced and III-2-aa lives with her mother. The family receives a number of benefits from social service agencies, including food stamps and child welfare.

Physical Environment:

a) The home is located in III-2, a city in the central part of the state.

b) Description of the home: The home is a four (4) room apartment in a large complex.

c) Location of the Learning Apparatus: The learning apparatus is located in the mother's bedroom.

Entering Behaviors:

Language:
- a) babbled
- b) said few single words: no, ma-ma
- c) cried

Motor:
- a) pulled to standing
- b) sat alone
- c) walked holding on to furniture

Social:
- a) responded (smiled and babbled) to adult attention
- b) had awareness of strangers

Cognitive:
- a) reached, grasped, put in mouth
- b) imitated pat-a-cake
- c) pincer grasp

Self-help:
- a) fed self with fingers
- b) ate mashed table food fed by parent
- c) held own bottle

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	4	=	24	
occupation	9	x	7	=	63	
education	5	x	5	=	25	
score of Index on social position					112	= IV

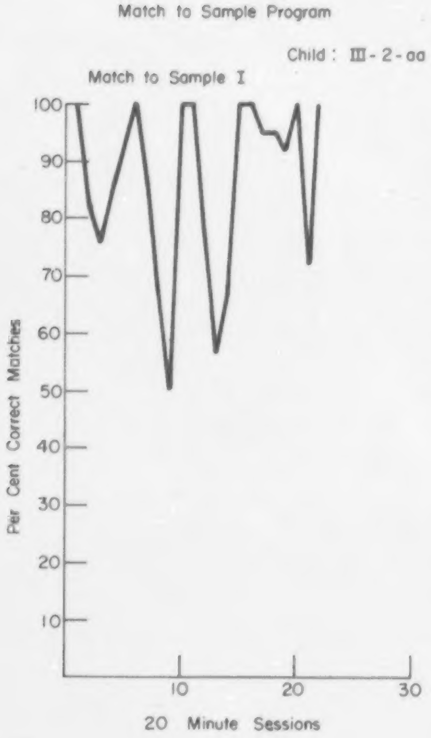


FIGURE 31

Figure 31 shows the results of child III-2-aa on the Match-to-Sample apparatus. The staff felt that child III-2-aa met the prerequisites for the Match-to-Sample programs; therefore, she was placed directly on the brightness matching program. The data show that the performance of child III-2-aa was inconsistent throughout the program. However, over the last 8 sessions, performance fell below 90% correct matches on only one session.

CASE HISTORY

Identification Code:
III-5-x

Location Code:
III-5

Date of Birth:
10/31/73

Parent Information:
Father's age: 29 years
education: high school
occupation: installs fire safety systems
Mother's age: 37 years
education: eighth grade plus two (2) years trade school
occupation: housewife
Siblings: 2 teenage half brothers from mother's previous marriage (not living in this home)
Primary Caretaker: Mother
Persons in home during day: Mother

Medical/Social Data:

III-5-x is a two and one half (2 1/2) year old male with severe microcephally and myclonic seizures. The child was enrolled in another full-time intervention program and withdrew from the project before data was collected.

Physical Environment:

a) The home is located in III-5, a large city in the northwestern part of the state.

b) Description of the home: The home is a five (5) room mobile home located in a large trailer park.

c) Location of the Learning Apparatus: The learning apparatus is located in the child's bedroom.

Entering Behaviors:

Language:	a)	had little production of few consonant speech sounds
	b)	cried
Motor:	a)	had no head/neck control
	b)	kicked legs and moved arms
Social:	a)	smiled at adult attention
	b)	cried at removal of adult attention
Cognitive:	a)	eyes followed moving object
Self-help:	a)	opened mouth for bottle
	b)	ate strained food fed by parent

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	4	=	24	
occupation	9	x	6	=	54	
education	5	x	4	=	20	
score of Index on social position					98	= IV

CASE HISTORY

Identification Code:
III-7-v

Location Code:
III-7

Date of Birth:
12/27/74

Parent Information:
Father's age: 24 years
education: 1 year of college
occupation: city policeman
Mother's age: 24 years
education: high school
occupation: housewife
Siblings: brother, 3 years
Primary Caretaker: Mother
Persons in home during day: Mother and brother

Medical/Social Data:

III-7-v is an eighteen (18) month old female diagnosed as having a seizure disorder and left spastic hemiparesis.

The family receives benefits from SSI.

Physical Environment:

a) The home is located in III-7, a small town in the cental portion of the state.

b) Description of the home: The home is a new six (6) room brick ranch-style house.

c) Location of the Learning Apparatus: The learning apparatus is located in the parents' bedroom.

Entering Behaviors:

Language:	a)	cooed
	b)	was beginning to babble
Motor:	a)	had control of head
	b)	sat with help
	c)	had impaired mobility and use of left side
Social:	a)	smiled at adult attention
	b)	held offered objects (right hand)
Cognitive:	a)	could track partially
	b)	reached for offered object (right hand)
	c)	put objects in mouth
Self-help:	a)	was beginning to finger feed
	b)	ate baby food fed by parent

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	3	=	18	
occupation	9	x	3	=	27	
education	5	x	3	=	15	
score of Index on social position					60	= III

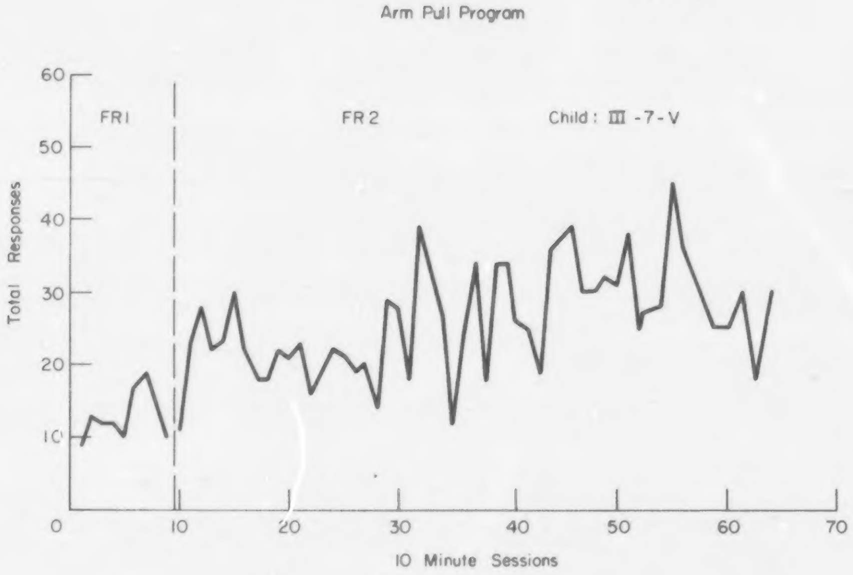


FIGURE 32

Figure 32 shows the results of child III-7-v on the Arm Pull apparatus. Staff evaluation indicated that child III-7-v was developmentally delayed on independent sitting behavior. As well as being an important behavior in its own right, independent sitting is a prerequisite for interaction with the Match-to-Sample apparatus. The data reflect a gradual increase in total responses across sessions 1-7. Performance decreased slightly on sessions 7-8 and increased sharply following the introduction of the Fixed Ratio 2 (FR2) reinforcement schedule. Subsequent to this initial increase, this schedule maintained responding at about 25 responses per session during the remaining sessions.

CASE HISTORY

Identification Code:
III-21-d

Location Code:
III-21

Date of Birth:
8/19/74

Parent Information:
Father's age: 23 years
education: GED
occupation: laborer with railroad
Mother's age: 24 years
education: high school
occupation: factory seamstress, currently on leave of absence
Siblings: none
Primary Caretaker: Mother
Persons in home during day: Mother

Medical/Social Data:

III-21-d is a one and one half (1 1/2) year old male, diagnosed at birth as jaundiced, having seizures and probable central nervous system hemorrhage.

III-21-d's parents recently separated and are in the process of obtaining a divorce. The mother is currently seeking financial and social services for herself and the child.

Physical Environment:

a) The home is located in III-21, a community in the south central region of the state.

b) Description of the home: The home is a five (5) room frame house.

c) Location of the Learning Apparatus: The learning apparatus is located in the child's bedroom.

Entering Behaviors:

Language:	a) produced few single sounds
	b) cried
Motor:	a) movement of arms and legs was random only
	b) had no neck control
	c) hands were fisted at all times
Social:	a) smiled in response to adult attention
	b) cried at removal of adult attention
Cognitive:	a) responded to sound
Self-help:	a) opened mouth for food

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	4	=	24	
occupation	9	x	7	=	63	
education	5	x	4	=	20	
score of Index on social position					107	= IV

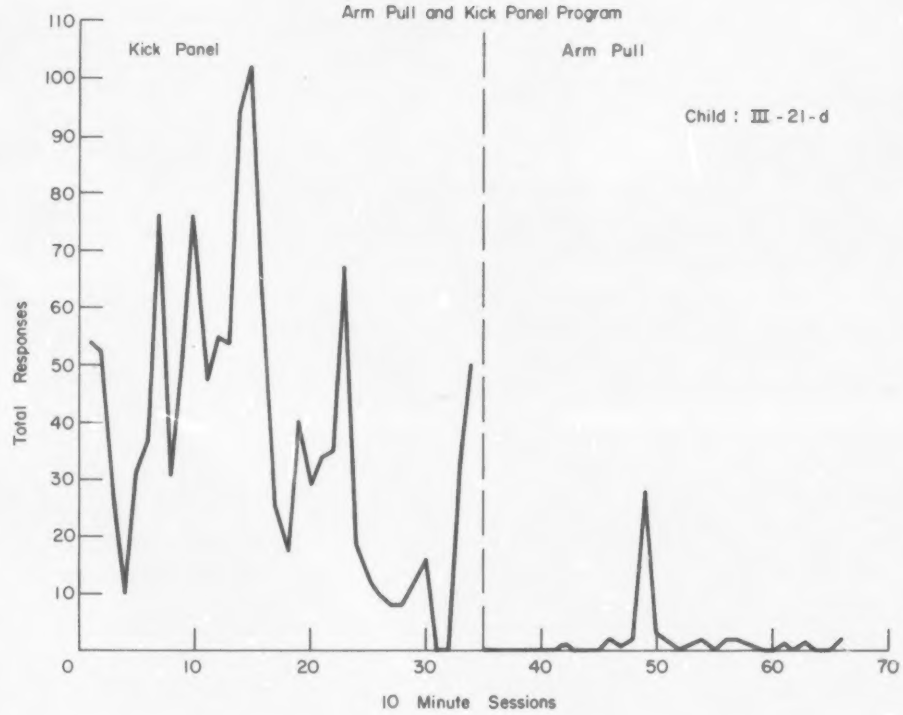


FIGURE 33

Figure 33 shows the results of child III-21-d on the Kick Panel and Arm Pull apparatus. Staff evaluation indicated that child III-21-d was developmentally delayed on independent sitting behavior and deficient in leg strength. The first 34 sessions of Figure 33 show child III-21-d's performance on the Kick Panel apparatus. While there was considerable variability in performance, there were several sessions during which child III-21-d emitted more than 50 responses. Sessions 35-66 show that the staff and parent had little success generating behavior on the Arm Pull apparatus.

CASE HISTORY

Identification Code:
III-22-b

Location Code:
III-22

Date of Birth:
3/29/69

Parent Information:
Father's age: 62 years
education: third grade
occupation: on disability
Mother's age: 42 years
education: sixth grade
occupation: housewife
Siblings: 8 living and 2 deceased
Primary Caretaker: Mother & widowed sister
Persons in home during day: Parents and widowed sister

Medical/Social Data:

III-22-b is a seven (7) year old male with Down's Syndrome. The family receives services from several social service agencies, including SSI, disability and food stamps.

The family members include the parents, several siblings, a widowed sister and her eight year old daughter.

Physical Environment:

a) The home is located three (3) miles from a paved road, approximately ten (10) miles from a small town in the south central part of the state.

b) Description of the home: The home is a three (3) room frame house with outdoor facilities.

c) Location of the Learning Apparatus: The learning apparatus is located in the bedroom the child shares with his parents.

Entering Behaviors:

Language:
- a) had few intelligible single words
- b) vocal production was mainly gibberish
- c) followed few simple commands

Motor:
- a) walked, gait unsteady
- b) walked downstairs, one step at a time

Social:
- a) acted to gain attention
- b) played independently with toys
- c) needed close supervision out-of-doors

Cognitive:
- a) scribbled on paper
- b) had pincer grasp
- c) identified body parts with help

Self-help:
- a) fed self with fingers
- b) drank from cup using two hands
- c) cooperated while being dressed
- d) had no toileting skills

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	5	=	30	
occupation	9	x	7	=	63	
education	5	x	7	=	35	
score of Index on social position					128	= V

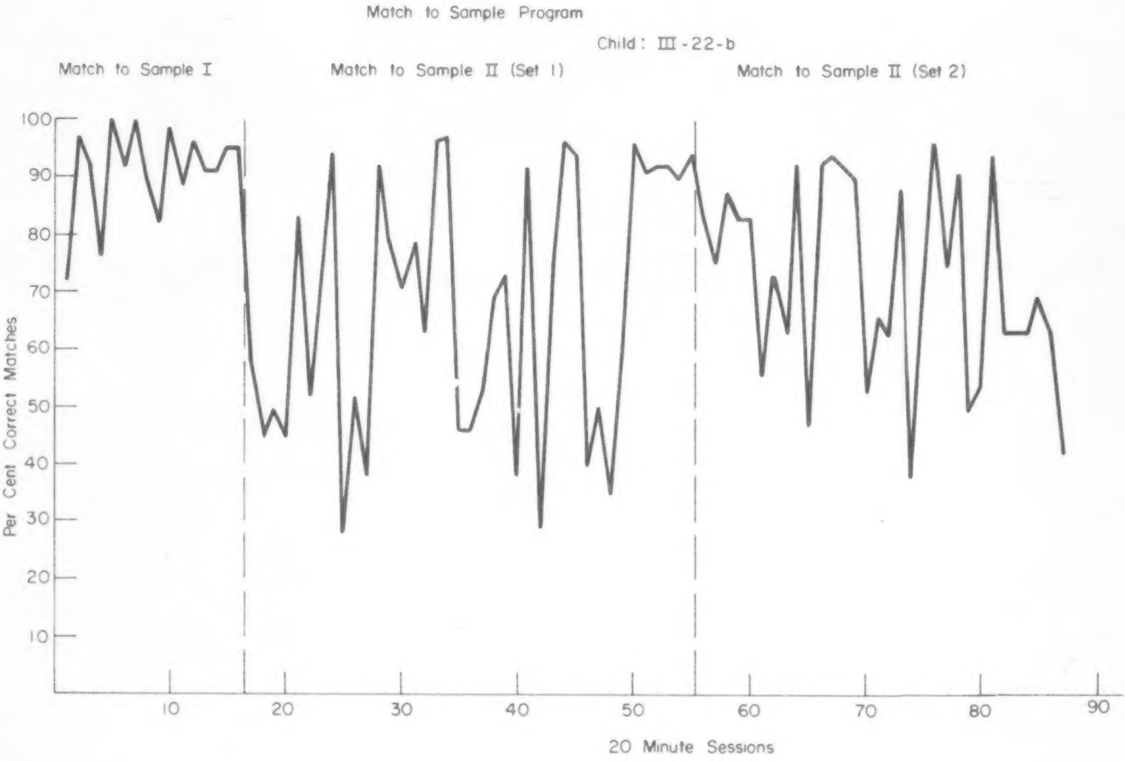


FIGURE 34

Figure 34 shows the results of child III-22-b on the Match-to-Sample apparatus. The staff felt that child III-22-b met the prerequisites for the Match-to-Sample program; therefore, he was placed directly on the brightness matching program. Figure 34 shows that child III-22-b acquired the brightness discrimination by session 16 and was placed on the Match-to-Sample II program. Following many sessions of erratic performance, child III-22-b's behavior reached a stable level of about 90% correct matches on sessions 50-55. At that time a second set of 3 letters was introduced resulting in the recurrence of the extreme variability of performance.

CASE HISTORY

Identification Code:
III-23-a

Location Code:
III-23

Date of Birth:
9/9/72

Parent Information:
Father's age: 28 years
education: high school plus vocational training in machine shop
occupation: maintenance work at aeronautics vocational school
Mother's age: 26 years
education: not known
occupation: not known
Siblings: none
Primary Caretakers: Grandmother & paternal aunt
Persons in home during day: Grandmother and aunt

Medical/Social Data:

III-23-a is a three and one half (3 1/2) year old female with cerebral palsy, mental retardation and partial bone marrow depression. No information is available on her prenatal or neonatal history. III-23-a's parents are divorced; she lives with her father, his parents, and paternal adult aunt and teenaged uncle. The father applied for SSI benefits for III-23-a but did not qualify.

Physical Environment:

a) The home is located .3 miles from the nearest paved highway, three (3) miles from III-23, a small farming village in the south central part of the state.

b) Description of the home: The home is a four (4) room frame house with a three (3) room addition on the back.

c) Location of the Learning Apparatus: The learning apparatus is located in the kitchen.

Entering Behaviors:

Language: a) said single words only
b) followed some simple commands
Motor: a) had limited use of legs, could move self in special walker
b) has spastic fine motor movements, as associated with cerebral palsy
c) held and manipulated some objects
Social: a) smiled and laughed appropriately in social situation (with adults)
b) had some appropriate play with toys
Cognitive: a) found hidden objects, if watching them hidden
b) pointed to and named pictures of simple objects (from limited choice)
c) identified some body parts

Self-help: a) was beginning to finger feed
b) was beginning to drink from cup
c) held own bottle

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	4	=	24	
occupation	9	x	6	=	54	
education	5	x	4	=	20	
score of Index on social position					98	= IV

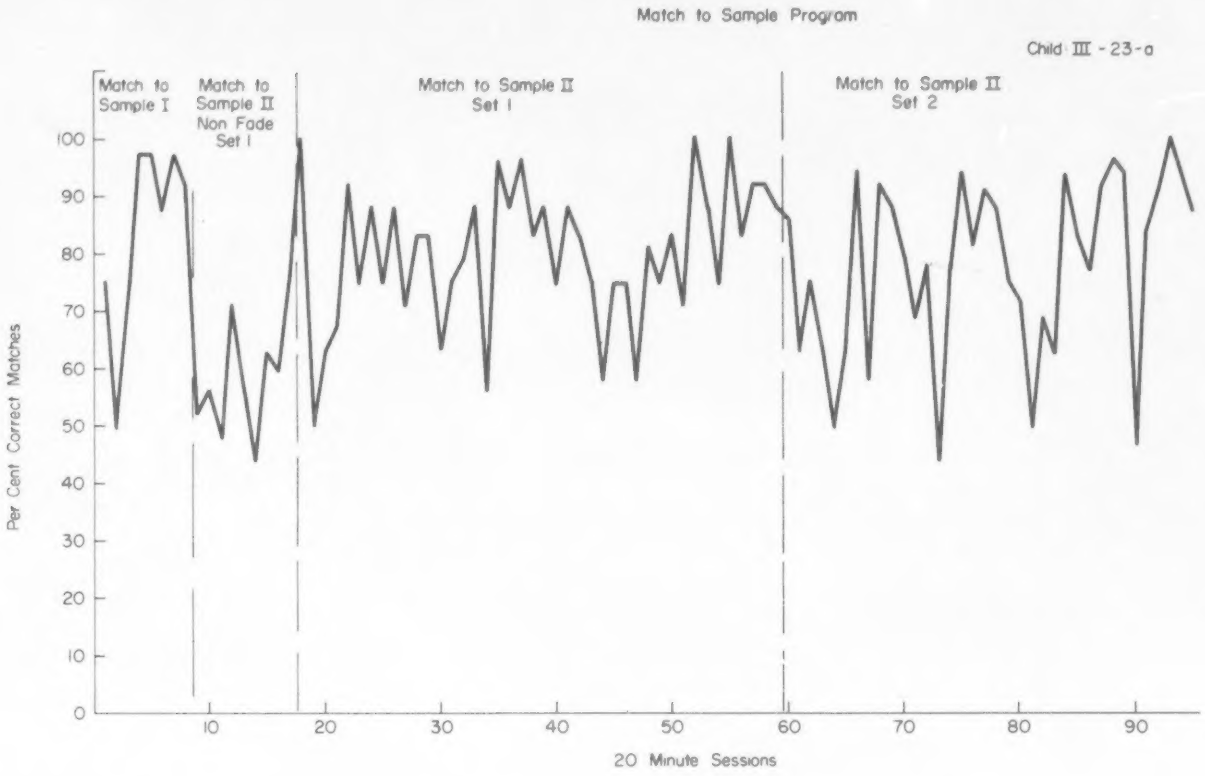


FIGURE 35

Figure 35 shows the results of child III-23-a on the Match-to-Sample I and II programs. The staff felt that child III-23-a met the prerequisites for the Match-to-Sample program; therefore, she was placed directly on the brightness matching program. The first 8 sessions of Figure 35 show the performance of child III-23-a on the Match-to-Sample I (brightness matching) program. The data reveal that after the first three sessions, child III-23-a responded correctly on about 90% of the trials. A non-fading letter matching program was in effect on sessions 9-17. The low percentage of matches on these sessions indicates that this child was unable to learn the discrimination when the stimuli were presented at equal distinctiveness values throughout the session. The introduction of a fading program on session 18 produced a considerable increment in performance. A second fading program containing three different letters was initiated on session 59. After an initial decrement and despite substantial variability, the data suggest the child did learn to discriminate the three new letters.

CASE HISTORY

Identification Code:
III-43-ab

Location Code:
III-43

Date of Birth:
4/25/75

Parent Information:
Father's age: 42 years
education: seventh grade
occupation: unemployed truck driver
Mother's age: 25 years
education: ninth grade
occupation: housewife
Siblings: four from father's previous marriage, living in another town; three half siblings from mother's previous marriage that live in the home.
Primary Caretaker: Mother
Persons in home during day: Mother and half sister

Medical/Social Data:

III-43-ab is a fourteen (14) month old female diagnosed as having characteristics of Down's Syndrome. Telecommunications Project installed a telephone for this family.

The family receives benefits from various social service agencies, including food stamps, medical assistance, child welfare and SSI.

Physical Environment:

a) The home is located in III-43, a small rural community in the west central part of the state.

b) Description of the home: The home is a four (4) room concrete block structure located on an unpaved city street. The house has outdoor facilities.

c) Location of the Learning Apparatus: The learning apparatus is located in the parents' bedroom.

Entering Behaviors:

Language:	a)	had limited production of single speech sounds
	b)	cried
Motor:	a)	had random movements of arms and legs
	b)	had no head control
Social:	a)	smiled when stimulated by adult
	b)	cried at removal of adult attention
Cognitive:	a)	eyes followed moving person
	b)	responded (smiled) to parents' voices
Self-help:	a)	opened mouth for food
	b)	helped hold own bottle

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	6	=	36	
occupation	9	x	7	=	63	
education	5	x	7	=	35	
score of Index on social position					134	= V

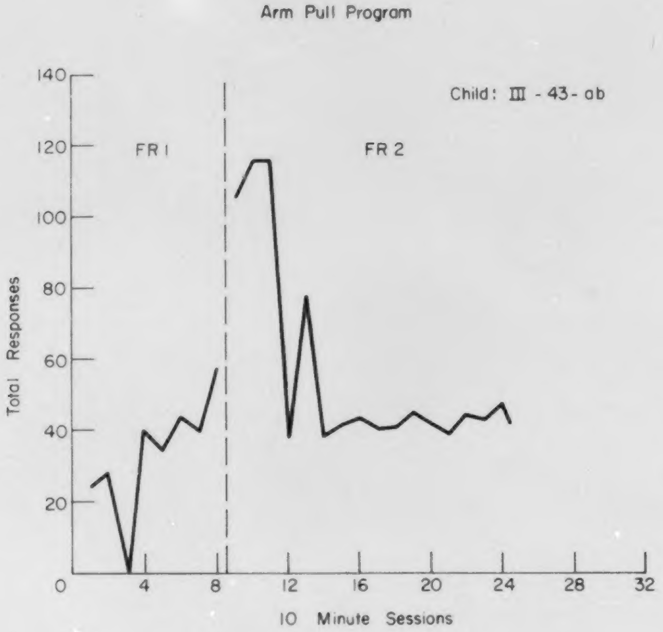


FIGURE 36

Figure 36 shows the results of child III-43-ab on the Arm Pull apparatus. Staff evaluation indicated that child III-43-ab was developmentally delayed on independent sitting behavior. As well as being an important behavior in its own right, independent sitting is a prerequisite for interaction with the Match-to-Sample program. The first 8 sessions of Figure 36 show that child III-43-ab gradually increased her total responses per session from 22 to 58. With the introduction of the Fixed Ratio 2 (FR2) reinforcement schedule there was a dramatic initial increase in responding. Performance then returned to the level that had been established prior to the schedule change.

CASE HISTORY

Identification Code:
III-48-ah

Location Code:
III-48

Date of Birth:
6/11/74

Parent Information:
Father's age: 30 years
education: high school
occupation: unknown
Mother's age: 26 years
education: high school
occupation: housewife
Siblings: 2 older sisters in the home -- fraternal twin died shortly after birth.
Primary Caretaker: Mother
Persons in home during day: Mother & sisters

Medical/Social Data:

III-48-ah is a two year (2) old female, found at birth to be premature with hyaline membrane disease and bronchopulmonary displasia. Records also indicate congestive heart failure and intraventricular bleeding which were corrected surgically at five (5) months of age.

III-48-ah's parents separated and divorced before her birth. The family receives benefits from a variety of social service agencies including public housing, public assistance and food stamps. The Telecommunications Project installed a telephone in this home.

Physical Environment:

a) The home is located in III-48, a small town in the central part of the state.

b) Description of the home: The home is a four (4) room apartment in the public housing project.

c) Location of the Learning Apparatus: The learning apparatus is located in the living room.

Entering Behaviors:

Language:	a)	babbled
	b)	said few single words: ma-ma, bye
	c)	laughed
Motor:	a)	pulled to standing
	b)	rolled over
	c)	sat alone
	d)	did not crawl
Social:	a)	smiled and babbled to adult attention
	b)	was aware of strangers
	c)	manipulated some toys
Cognitive:	a)	imitated pat-a-cake
	b)	was beginning pincer grasp
Self-help:	a)	was beginning to finger feed

b) held own bottle
c) ate baby food fed by parent

Socioeconomic Status Scale:

factors	factor weight	x	scale value	=	partial score	Class
residence	6	x	5	=	30	
occupation	9	x	7	=	63	
education	5	x	4	=	20	
score of Index on social position					113	= IV

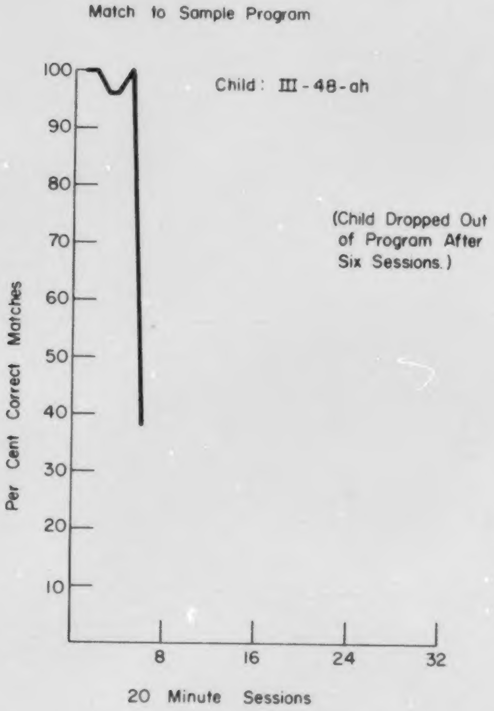


FIGURE 37

Figure 37 shows the performance of child III-48-ah on the Match-to-Sample apparatus. The staff felt that child III-48-ah met the prerequisites for the Match-to-Sample program; therefore, she was placed directly on the brightness matching program. Child III-48-ah withdrew from the program after so few sessions that it was difficult to make generalizations about her performance. However, the data indicated that she was matching at better than 90% correct until her last session.

SECTION SEVEN

CONTRIBUTED SERVICES FROM THE UNIVERSITY OF KENTUCKY CENTER FOR THE HANDICAPPED

During the course of the project, the University's Center for the Handicapped (UCH), a UAF affiliate, volunteered to provide extensive diagnostic examinations of all project children. This activity was not part of the work scope of the project. However, project staff coordinated communications between the UCH and families. These activities, and the outcomes of the medical interventions, are described in this section. It should be noted that coordinated health and social service delivery has been suggested as an attribute of a Telecommunications system. The type of activity described here provides an example of such coordination. To carry out this activity, project staff:

1. developed a working plan in cooperation with UCH staff
2. conducted project orientation sessions for UCH staff
3. filled out and returned referral forms to UCH
4. assisted families in filling out developmental forms sent to them by UCH
5. assisted families with travel arrangements
6. assisted families with hospital admission procedures
7. conducted group meetings with parents to:
    a) reinforce parent to parent communication
    b) present project related slide programs
8. conducted on-site demonstration of project facilities and activities, including computer operations during instructional sessions
9. conducted individual meetings with families to discuss children's progress and data
10. participated in disposition conferences at UCH
11. served as liaison between UCH and parents to interpret the results of the evaluation

The outcomes of the comprehensive examinations are shown in Table 8 which lists all medical or therapeutic interventions. Not shown are referrals or actions which were initiated in three instances where evaluations concluded there was sufficient evidence of a parent's drug abuse or child abuse to warrant intervention from appropriate agencies.

TABLE 8

SCOPE OF EVALUATION

The medical examination included a routine examination and specific evaluations as appropriate in these areas:

Unit	Tests Administered
Speech and Hearing	Peabody Picture Vocabulary Test Pre-School Language Scale Goldman-Fristoe Test of Articulation Verbal Language Development Scale (Mecham) Examination of Oral Peripheral Mechanism Bzoch-Teague Receptive Expressive Emergent Language Scale Audiometric testing Houton Test for Language Development
Psychology	Stanford Binet WISC Vineland Maturity Inventory Family Environment Scale
Physical Therapy Consultation	
Social Work	Family Assessment Interview
Nursing Summary	Observation and interview of parents
Educational Evaluation	Peabody Picture Vocabulary Test Vineland Maturity Inventory School Readiness Survey Informal observation to ascertain child's knowledge of basic concepts and motor skills, e.g. matching, coloring, block building, colors, numerical concepts Verbal directions

TABLE 8 (cont.)

BENEFITS OF EVALUATION

Child	Medical	Physical Therapy	Speech and Hearing	Other
I-9-t	Detected enlarged kidney and malfunction, treatment including surgery to avoid loss of kidney.			
I-13-p		Referred to local physical therapist.		
I-16-1		Parents instructed on use of vibrator on child's neck to facilitate head control. Wheelchair prescribed to assist handling of child.		
II-17-k	Changed previous diagnosis. Family physician notified to do further metabolic tests and genetic tests and counseling for parents and other sibling. New diagnosis had genetic implications. Prescribed chlorohydrate to change child's sleeping patterns to allow family to return to normal daily routine to facilitate functioning of family.			

TABLE 8 (cont.)

Child	Medical	Physical Therapy	Speech and Hearing	Other
II-20-f		Brace for one leg ordered, slight damage to one leg was detected. This prosthetic device was prescribed to prevent further damage. Child received continuing physical therapy from Medical Center.		
III-7-v		Referred to local physical therapist to facilitate proper development, develop left side to prevent total paralysis.	Mother received instruction on language stimulation techniques.	Mother returned to Medical Center for behavior management instruction.
III-21-d	Neurology follow-up with change in medication to control seizures since prognosis was poor due to inability to control seizure, i.e. 1/2 cases like this do not survive past 5 years. Mother received counseling from social worker in neurology.	Therapist demonstrated how to handle child to facilitate head control.	Language stimulation techniques suggested to mother.	
III-23-a		Recommendation for child to crawl as continuous use of walker was causing deformity. Prognosis good for walking. Child returned	Referred for speech therapy to local agency.	

TABLE 8 (cont.)

Child	Medical	Physical Therapy	Speech and Hearing	Other
III-23-a continued		to Medical Center for physical therapy.		
III-43-ab			Therapist discussed language stimulation techniques and referred parents to local therapist. An appointment was made to return for hearing evaluation in six months to detect possible hearing loss.	

SECTION EIGHT

COST ESTIMATES FOR A PROTOTYPE SYSTEM

Introduction

Cost estimates have been prepared for a prototype system. These estimates are not based on the actual costs incurred during the award period, for these reasons:

1. actual costs reflect prototype design and construction, not the purchase of standard items
2. no costs were incurred for computer use since the system had been purchased and was being used on another BEH supported project
3. major personnel costs were invested in debugging the system
4. learning devices placed in the homes were simple prototypes designed specifically for the project, not standard devices with a fixed cost
5. project administration costs are not representative of actual costs for a prototype center

Given these factors, and given that there has been no full-scale test with a sufficient number of children to test the maximum capacity of the system. cost estimates for a replication prototype system have been developed. Cost per family per year estimates have been calculated. It must be emphasized that these estimates contain projections on product life which are not based on performance histories, e.g. computer life is estimated at 10 years. In fact, a computer may operate indefinitely with a widely varying maintenance cost; or a system may be replaced because it is obsolete though still functional.

General Assumptions Underlying Cost Estimates

1. The system projects that 60 children may receive instruction on a daily basis, without exhausting the capacity of the computer system.
2. The INTERACT system contains 4K of core memory. (Additional units of 4K may be added to the system)
3. A WATS system will be utilized. Current rental figures of $75 per month per line plus 10¢ per minute per line have been used for this estimate.
4. Thirty minute sessions are projected for each child, and an eight hour (16 session) day is projected.

5. The cost of full-scale production (second generation) modem interface/parallel-to-series units will remain the same if increased production demand emerges.

6. A full scale system will support the cost of telephone installation and monthly service for a small percentage of the total families. Those costs are not included in the budget projections.

7. The cost of home placed learning devices ($300) is a reasonable estimate whether production items are manufactured or individual devices are built as prototypes for an extended time period.

8. The administrative costs will be absorbed by the sponsoring agency. Therefore, personnel costs for direct operations staff are included here.

9. Many home placed learning devices will be used for short periods by one child, will be loaned to other families, and will remain in constant use.

10. There are 250 days in an instructional year.

TABLE 9

COST ESTIMATES FOR A REPLICATION PROTOTYPE TELECOMMUNICATIONS SYSTEM

Category	Item	Purchase Cost	Product Life	Cost Per Year (life/cost)	Number of Users Per Year	Cost Per User (child per year)
Computer and peripheral hardware	INTERACT computer with 12K memory	$25,000	1[illegible] years	$2,500.00	60	$41.67
	Modem interface units					
	a. remote unit (1 per home)	2,500	12 years	208.33	1	208.33
	b. local unit (8 per center)	6,400	12 years	8.89	60	8.89
	Acoustic coupled modem					
	a. home (1 per home)	315	12 years	26.25	1	26.25
	b. hard-wired modem (8 per center)	2,520	12 years	210.00	60	3.50
Telephone lines	Line rental for eight (8) lines	$75.00/mo.	--	$7,200.00	60	$120.00
	Line service cost	.10/min.	--	45,000.00 (.10 per min. X 30 min. per day X 250 instructional days X 60 users)	60	750.00

TABLE 9 (cont.)

COST ESTIMATES FOR A REPLICATION PROTOTYPE TELECOMMUNICATIONS SYSTEM

Category	Item	Purchase Cost	Product Life	Cost Per Year (life/cost)	Number of Users Per Year	Cost Per User (child per year)
Home placed learning devices	Devices	$27,000 (90 devices X $300 each)	3 years	$9,000	60	$150.00
	Consumables					100.00
	Maintenance					100.00
Personnel	Programmer			$12,000.00	60	$200.00
	Liaison coordinator (4)			10,000.00 each	60	666.67
	Line operator (2 @ $2.50/hr.)			5,000.00 each	60	166.67
	Data clerk (1 @ $2.50/hr.)			5,000.00	60	83.33
	Electrical services (contractual)			5,000.00	60	83.33
Travel				$4,800.00	60	80.00
Center facilities	Rental/maintenance			3,600.00	60	60.00
					TOTAL	$2,848.64

In summary, it must be emphasized that these cost estimates have been prepared on the basis of a number of untested assumptions. The total cost of the system reflects the price to a new user desiring to replicate the system at the present time. Projected cost increases, inflation and other unknown figures are not included in cost per year estimates.

It should also be noted that the cost per child per year can be further reduced to a cost per unit of instruction, if a representative mean number of responses can be projected, e.g. the cost per child per day is approximately $11.00. Estimating 1.5 responses per minute for a 30 minute session, a figure of 25¢ per response can be derived. No serious attempt to make a fine estimate has been made, since there are so many unknowns in the total equation. It is sufficient to note, however, that such projections can be made and that another step, cost per unit of correct responses, per day, is not far away.

An estimated cost of $2848.64 per child per year has been calculated. This figure may be compared with the cost of institutionalization, or the cost of educating a child in a public or private preschool program, or in public education programs. These comparisons would indicate a favorable cost for the Telecommunications system. Finally, costs and benefits for coordinated social service delivery have not been indicated and await further development before accurate estimates can be made.

SECTION NINE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The outcomes of a two year contract to develop the technology for a telecommunications system for severely handicapped children and youth have been described. Key elements of the content of the request for proposals (RFP 74-5) have been listed. The nature of the Kentucky response -- to engage in technology development to link an interactive minicomputer to homes via a telephone transmission system -- has been identified. The presumed benefits of early intervention -- from birth onward -- have been discussed. The strategies conducted during the award period have been chronicled, and data have been presented on those outcomes.

In summary, prototype linking devices were designed, built and tested. First generation production models were delivered, enabling project staff to establish learning environments in seventeen homes dispersed across the state. Daily data transmission was initiated to each home site. Home intervention and field liaison were initiated on a limited scale. In conjunction with the University Medical Center (Center for the Handicapped), medical evaluations were arranged for all children, and a variety of health related benefits were provided. In view of the progress made during this contract period, recommendations for the development of additional contracts were made to the funding agency -- and strategies have been implemented to continue service delivery to a limited number of homes in close proximity to the project site. The implications and recommendations are described in question form and are intended to emphasize the factors which will influence full-scale development of a futures oriented technology.

Issues Related to the Future of Computer-Telephone Telecommunications Systems

Factors which will determine the future of Telecommunications systems such as this are found within and beyond the scope of this final report. Questions are raised in this section which discuss the data gathered during the conduct of the project. In addition, questions are raised which can only be answered by further research and development efforts.

Which is the Appropriate Perspective on the Costs for a Computer-based Telecommunications System?

Cost figures have been presented in Section Eight, along with qualifying statements and the judgements used for those estimates. It has been emphasized that those costs are tentative and that the total capacity of this system has not been tapped.

Can a Computer-Telephone Linkage be Effected for On-line Processing of Instructional Programming?

Certain types of computer generated telephone data transmission systems are becoming commonplace. In business, salesmen utilize brief-case sized acoustic couplers to place orders for merchandise. Research facilities have had the capacity to transmit computer data over telephone lines for an extended period of time. During the course of this project, it was demonstrated that an interactive computer system could be linked to sites geographically distant from the computer center and that daily instructional sessions could be conducted in home settings. As noted, this system is designed for on-line control of behavioral events and is interactive, receiving and returning signals within 100 milliseconds. The data indicate that an interactive computer could be linked to each home and that daily interaction could occur.

Does the System Work Reliably?

The data in Table 1 indicate a range of reliability from 42 to 92 percent. Across Kentucky, telephone subscribers are served by a large number of small companies. As noted, four placements among the five with the lowest reliability were served by the same small system. These figures are encouraging, in view of the fact that there was a mean number of 120 days for system testing in the shortened test period; that problem solving was required for each component of the Telecommunications link as well as with the integrated system; and that extensive time was required to troubleshoot minor problems after the learning station was installed in the home. An extended test period, subsequent to solving minor errors, is required to provide an estimate which is not spuriously low. It would appear that a 90% reliability is a reasonable estimate, acknowledging that in some locales the poor quality of telephone transmission may preclude reaching that level. Further technology development will be necessary to determine if the system will reach 100% reliability in all sites.

Will Telecommunications-Delivered Instruction Deliver a Better Education, in Comparison to Other Curricula and Delivery Systems?

The answer to this question lies somewhere in the future. The question is among those most frequently asked when the project is described. In order to answer the question in hypothesis form, elements must be produced which do not exist in 1976. It has been noted repeatedly throughout this report that the nature of this project is technology development. The next step is to conduct full-scale demonstration, once all technology development tasks are completed. Then, a valid or effective curricula must exist, to be compared to another. Given the status of present full-scale curriculum development projects, it will be some time before "effective" curricula exist. Therefore, the question is somewhat premature, by three to seven years, in the author's best estimate. On another dimension, this may not be the most appropriate question. Telecommunications-based educational and social service delivery, as described in the chapter in Appendix A, is a multiple "treatment", incorporating direct instruction to child and parent and in effect, an individualized intervention program. Further, given the heterogeneity, incidence, and geographical dispersion of the target population, such a comparison study may not be feasible. Thus, the question is premature in the author's view, may not be the proper question, and, if it is, will be extremely difficult to answer.

What Content, Scope and Sequence Can Be Taught by This Computer System?

For the infant and young child, visual discrimination, concept learning, math and reading instruction can be presented by computer. Simple response manipulation can be used to establish performance that is characteristic of reinforcement on a V5 schedule, a high and stable rate of responding. Response devices can be constructed to shape a variety of motor responses, e.g. kicking, pulling, pushing actions. Obviously, language, and self-help instruction are not likely to be taught by computer. Social skill development, defined as adult-child or child-child interaction, cannot be taught by computer. However, programs which require parent-child-computer interaction will teach, directly or indirectly, something about the principles of reinforcement. And, those behaviors can be taught by the field liaison personnel who maintain interaction with the families. What has been learned from this experience is that the computer is one component of a delivery system. Computer generated instruction may be presented in a variety of ways and will hold varying degrees of importance during a five to ten year period of intervention in the life of an infant and young child.

What Functions Does the Computer Perform in a Telecommunications Delivery System?

1. Present daily instruction, beginning in the first year of life, continuously through the course of a program of education intervention
2. Store academic performance histories
3. Store social service intervention
4. Compute data and provide output to peripheral devices to generate graphs and other data summaries
5. Store relevant accounts of programs conducted by therapists and other interventionists

Is This System Designed to Provide a Type of Homebound Instruction Which Might Supplant, or Substitute for, a Public School Placement?

This system was designed to provide instruction to infants and young children who are geographically removed from existing programs, who live in areas where programs do not exist, or who are unable to travel to the closest program. Instruction can be provided daily. With further curriculum and technology development, it can be projected that instruction can be provided for a significant portion of the time. In contrast, in Kentucky for example, homebound instruction, by regulation, may be conducted for a minimum of two hours per week. The Kentucky Telecommunications system envisions a field liaison coordinator who will perform the functions of a homebound instructor in addition to other duties. It is also feasible to train homebound teachers in a region served by telecommunications, so that those responsibilities might be supported by the local district. In all cases, telecommunications transmission is considered an integral part of a total system, rather than one designed to substitute for another service.

Conclusions and Recommendations

In retrospect, a first step has been made in the development of the technology for a telecommunications system which is based on an interactive computer control system. A blueprint for a full-scale system was written during the course of the project and is included in Appendix A. At this writing, through University contributions and a small amount of unexpended project funds, a third year of service will be delivered to a small number of families within close proximity to the project site. This period will enable further testing of the system and will produce more representative system reliability figures, accomplishing another small step forward.

Briefly, we found that the system will work, that families will accept the intrusion of technology in their homes. We know that they cooperated with us for an extended period of time; we do not know how long they might continue to participate if they were able to do so indefinitely. That will be determined by further research and development.

Child performance data indicate that children will engage an apparatus daily. In some instances little change or acceleration was shown, in some instances performance was variable, and in others a high and stable number of correct responses were emitted during daily sessions.

We did not propose a coordinated curricular intervention with the computer, knowing that none presently exist for infants and very young children. The necessity for such a curriculum, and for birth-onward intervention, became clearly established during the course of the project.

Parent training through field liaison staff intervention was proposed. The necessity for extended debugging of the system restricted the amount of time available to accomplish the task and set out the parameters for expanding the functions of this role to coordinated educational and social service coordinator. This next step should be accomplished during the 1976-77 test period.

Perhaps the most obvious fact to emerge from this experience is the fragility of the support base for the development work necessary to develop all the components of a prototype system. This project, and the other four Telecommunications projects, were funded under two year "stimulation" contracts -- to develop systems that other agencies would incorporate and support. The final goal for the Kentucky system would be full-scale replication in other remote, sparsely populated, or geographically isolated areas. Whether that goal will be met is entirely contingent upon additional support for a wide range of development activities.

It is de regueur to end a report such as this with a recommendation that additional funding be awarded to pursue the topic (development of telecommunications systems) or to engage in additional research to answer those new or yet unanswered questions generated by this present body of work. This report is no exception.

The author and his associates believe that:

1. An infant curriculum should be developed which incorporates computer generated and adult controlled learning experiences.

2. Funding should be assured to bring this system and others to full-scale implementation.

3. The blueprint for a model telecommunications system, as described in Appendix A, should be "built" and tested.

4. A new type of professional role, the field liaison coordinator, should be fully developed as a model system is implemented.

5. Data systems should be established to permit documentation, at some future time, of the amount and type of intervention required to monitor a child with severe and multiple handicapping conditions in home environments which may be marginally adaptive at best.

6. Intervention should begin at birth and continue until no agency identifies a need for it for a specific child.

7. The potential of the telecommunications system in infant learning research in the home should be fully explored.

8. The potential of the telecommunications system for obtaining longitudinal data on children and families should be fully explored.

9. BEH should support a national meeting to present the results of the projects funded under RFP 74-5 (Telecommunications) and RFP 74-10 (the first of the model centers for the severely handicapped).

REFERENCES

Allyon, T. and Azrin, N. *The token economy: A motivational system for therapy and rehabilitation*. New York: Appleton-Century-Crofts, 1968.

Bijou, S. A functional analysis of retarded development. In N. Ellis (Ed.), *International review of research in mental retardation*, Vol. 1. New York: Academic Press, 1968, 1-19.

Bijou, S., Birnbrauer, J., Kidder, J. and Tague, C. Programmed instruction as an approach to teaching of reading, writing and arithmetic to retarded children. In S. Bijou and D. Baer (Eds.), *Child development: Readings in experimental analysis*. New York: Appleton-Century-Crofts, 1967, 309-329.

Children's Defense Fund, *Children out of school in America*. Cambridge, Mass., 1974.

Cohen, H. Programmed alternatives to punishment: The design of competence through consequences. In *Behavior modification*. New York: Academic Press, 1972, 63-84.

Ferster, C. and DeMeyer, M. A method for the experimental analysis of the behavior of autistic children. *American Journal of Orthopsychiatry*, 1965, *32*, 89-98.

Fitzgerald, H. and Porges, S. A decade of infant conditioning and learning research. *Merrill-Palmer Quarterly*, 1971, 79-117.

Hobbs, N. *The futures of children*. San Francisco: Jossey-Bass, 1975.

Hollingshead, A. and Redlich, F. *Social class and mental illness*. New York: John Wiley & Sons, Inc., 1958.

Hulsebus, R. Operant conditioning of infant behavior: A review. In H. Reese (Ed.), *Advances in child development and behavior*. New York: Academic Press, 1971, 111-158.

Lake, T. Programs providing alternatives: Educating the severely and multiply handicapped. *Education and Training of the Mentally Retarded*, Vol. 9, No. 1, February, 1974.

Lindsley, O. Direct measurement and prosthesis of retarded behavior. *Journal of Education*, 1964, *147*, 62-81.

Pennsylvania Association for Retarded Children v. Commonwealth of Pennsylvania. Civil Action No. 71-42, *Order, Injunction, and Consent Agreement*, United States District Court for the Eastern District of Pennsylvania, 1971.

Proceedings of the conference on research needs for the severely handicapped. United States Office of Education - Bureau of Education for the Handicapped, 1975.

Request for Proposal 74-5, Telecommunications for severely handicapped children and youth. Bureau of Education for the Handicapped, U.S. Office of Education, Washington, D.C., 1974.

Screven, C., Straka, J. and LaFond, R. Applied behavioral technology in a vocational rehabilitation setting. In V. Gardner, Behavior modification in mental retardation. Chicago: Aldine-Atherton, 1971, 315-359.

Sidman, M. and Stoddard, L. Programming perception and learning for retarded children. In N. Ellis (Ed.), International review of research in mental retardation, Vol. 2. New York: Academic Press, 1966.

Tawney, J. Programmed environments for developmentally retarded children: A project for a coordinated program of research, program model development and curriculum development and dissemination. Project No. 233118 (original proposal), 1972.

Tawney, J. Programmed environments for the developmentally retarded. In P. Mann (Ed.), Mainstream special education. Washington, D.C.: Council for Exceptional Children, 1974.

Tawney, J. Educating severely handicapped children and their parents through telecommunications. In N. Haring, E. Sontag and L. Brown (Eds.), Teaching severely and profoundly multihandicapped children. New York: Grune and Stratton, Inc., in press.

Tawney, J. and Hipsher, L. Systematic language instruction, Project No. 7-1205. United States Office of Education, 1970.

Ulrich, R., Louisell, S. and Wolfe, M. The learning village: A behavioral approach to early education. Educational Technology, 1971, 11, (2), 32-45.

White, B. Human infants. Englewood Cliffs: Prentice-Hall, 1971.

Wolfe, M., Phillips, E., and Fixen, D. The teaching family: A new model for the treatment of deviant child behavior in the community. Behavior modification. New York: Academic Press, 1972, 51-62.

APPENDIX A

EDUCATING SEVERELY HANDICAPPED CHILDREN AND THEIR PARENTS THROUGH TELECOMMUNICATIONS

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Educating Severely Handicapped Children and Their Parents Through Telecommunications

James W. Tawney, Ph. D.

University of Kentucky

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EDUCATING SEVERELY HANDICAPPED CHILDREN AND THEIR PARENTS THROUGH TELECOMMUNICATIONS

Abstract

The right to education and normalization movements are creating a demand for new delivery systems to educate those who are severely handicapped. Early intervention, home placement, and utilization of community resources are proposed as alternatives to institutionalization of children who manifest severe and multiple handicapping conditions. This means, in brief, that education must be provided to persons who have not been recipients, at an age when educational services have not been rendered, and that additional supportive services must be provided to parents to enable them to manage and educate their children. The magnitude of the task requires the development of innovative and cost effective delivery systems. This chapter describes the application of telecommunication technologies to home education of severely handicapped children and their parents. Five prototype telecommunications systems are described. Multiple functions of a model telecommunications system are listed. Potential combinations of single systems are projected. Recommendations for future system development and utilization are considered, particularly those which relate to the potential for long term research and curriculum development.

Brown vs. Board of Education precipitated a social revolution which has altered the fabric of American education repeatedly for the past twenty years. The fact of inequality exploded into public view and has remained there continuously, kept current by disclosure of educational practices which are discriminatory to children. A commitment to provide equal educational opportunity has generated a variety of experimental programs designed to reduce past inequities and foster maximum intellectual growth in all of societies' children. As intervention strategies were developed to provide equal educational opportunities, it became apparent that a social experiment of massive proportions was under way. Preschool programs emerged, to be followed by infant development and home training projects. While the effects of these programs were being debated, parents of handicapped children began to discover that minorities were not defined exclusively by color. An analysis of existing laws and traditional educational practices showed that children with severe handicapping conditions were excluded from public education programs. Through litigation, *PARC vs. Commonwealth of Pennsylvania*, parents sought and obtained a remedy to the situation. This, and subsequent legal action, established the *right to education* movement for all handicapped children. This movement has received national attention and served to accelerate changes in practices related to the care and treatment of the handicapped, particularly the mentally retarded.

The contrast between basic human rights and living conditions in institutional settings has increased pressure to remove children from institutions and return them to their home communities. In the same way that busing has been employed as a device to integrate racial groups to achieve a more normal social environment in the next decade, numerous strategies are being employed to bring handicapped and non-handicapped persons into daily interaction to "normalize" experiences for both groups. These actions have initiated a social experiment equal in significance to the original civil rights movement. If successful, children will no longer be placed in institutions. Instead, they will remain in home settings, receive educational intervention from birth through adulthood, and maintain a degree of independent living with the assistance of community-based service agencies. The dimensions of this social experiment are not confined to the generation of new delivery systems. Instead, the real experiment is a test for social acceptance of human variation. The outcome of *normalization* and *right to education* is the presence of individuals in a society which has historically rejected them because of extreme behavioral and physiological deviations from an inferred cultural norm. This dimension appears to have received little professional attention, an oversight which must be remedied to insure comprehensive planning.

Extreme effort will be required of parents as they work to develop a supportive home environment for their children. An equal effort will be required of professionals as they address the managerial and human factors which will ultimately determine the success of evolving support systems. The magnitude of the task requires that the problems must be fully conceptualized, that sufficient resources must be obtained, and that the most advanced technologies must be incorporated into efforts to develop prototype educational and social service delivery systems to support community placement of severely handicapped children.

This chapter will describe preliminary attempts to utilize emerging telecommunications technologies to teach children and to support parents whose severely handicapped children remain at home. This support is provided in the form of direct instruction to children and parent education. The systems deliver instruction to severely impaired children from birth to adulthood who represent the full range of handicapping conditions. The focus, however, is on severe learning and behavior disorders in children from birth to six years of age.

A RATIONALE FOR THE DEVELOPMENT OF TELECOMMUNICATIONS TECHNOLOGIES

Throughout this discussion, it will be important to keep in mind that descriptions of telecommunications systems and their functions have two referents in time: what can be done today and what may be done in the future. This section considers the factors which have encouraged the development of five prototype systems and the immediate goals they are designed to meet. Subsequent sections describe how systems may be used in the future. A critical factor will emerge to link the time referents; the utility of the systems to initiate systematic intervention from birth through the early school years. A brief rationale for early intervention will bridge the gap between present and future.

Immediate needs for alternative educational delivery systems

Traditionally, children go to school on foot or by bus. If they deviate to some degree from other children, their destination is a special class placement. If they deviate significantly, they do not go to school at all. For some children with temporary injury or permanent health impairments, school may come to them in the form of homebound instruction or, in extremely rare situations, in the form of a telephone link to the classroom. For children who deviate significantly in intellectual or behavioral attributes, the traditional social response has been to remove them from their homes and place them in institutions where they may or may not have the opportunity to go to "school". Sometimes, when mountains, flooding rivers, or cultural barriers exist between home and school, children simply do not go to school at all. The barriers supercede the issue of deviance. The traditional public view, in summary, has been stated very directly: "You go to school or you do not. If you do not fit, you stay at home. If you do not go to school, you may receive limited home instruction, if it is convenient to do so. If it is not convenient, you will not be served." However, the practices which were an outgrowth of the traditional view have been declared unconstitutional, and alternative methods must be found to educate those children who have been excluded from school. Concurrently, the number and types of excluded children are becoming increasingly more visible as a result of court-directed identification programs and the efforts of child advocacy projects (see Children Out of School, a report by the Children's Defense Fund, 1974). The pressure to alter traditional practices has intensified the search for nontraditional delivery systems. In a society that has become increasingly oriented toward the use of technology to solve major problems, the development of telecommunications systems is a logical strategy to circumvent geographical and political barriers. Similarly, as traditional age restrictions are being changed, telecommunications systems are looked upon as viable alternatives to serve new and younger populations, particularly in the 0-6 age range. The immediate goals of the emerging prototypes are clearly identified, as are the populations they will serve.

A basic objective of a telecommunications system is to deliver instruction to children who are geographically isolated from instruction. Severely handicapped persons are a relatively low incidence population, particularly when they represent combinations of handicapping conditions. When such persons are located in sparsely populated areas, or in areas which are isolated by geographical barriers, the service delivery problem is intensified. Telecommunications systems offer a variety of ways to link homes in remote locations with a central instructional unit. Telephone or television transmission systems can provide daily instruction of a higher quality than that provided by present itinerant, homebound services.

There are, among the population of excluded children, those whose health is impaired to such a degree that education in traditional public school classes is considered unfeasible. This population is, presumably, heterogeneous in age and level of intellectual functioning. Computer assisted instruction systems, transmitted via telephone or television, have been developed to provide home instruction appropriate to this heterogeneous group. Several years of work have gone into the development of curricula for CAI systems. These curricula are sufficiently comprehensive to provide a range of instruction in the traditional elementary and secondary content areas. Limited curricula exist, and more are being developed, to deliver instruction to persons who presently function below the traditional content areas. It is unlikely that the content of instruction and existing single delivery systems are adequate to serve this heterogeneous group. However, an immediate goal of the prototype systems is to expand programming capacity to serve those persons who have no other alternative.

Presently, many excluded children remain at home and that placement is tenuous at best. Some are school age but have been excluded because they are presumed to be severely retarded or manifest severe behavior disorders. Others have not yet reached mandatory school age but manifest such extreme intellectual or behavioral defects that their families may be considering institutional placements. Telecommunications systems will perform three immediate functions for these family units: assist parents in managing their children, teach parents to teach their children, and provide direct instruction to children. It is presumed that these interventions will raise children's functional levels, reduce behavior management problems, and reduce the probability that the child will be institutionalized.

Compensatory education programs began at the preschool level, then worked backwards to infant training, parent training, and home education programs. A similar trend has developed among those concerned with the education of the severely handicapped. For chilren with sensory impairments in vision and hearing, the necessity for early education has been acknowledged by legislation which permits public education at an earlier age than non-impaired children. Precedents are being established for all handicapping conditions, from birth to the present mandatory school age (and beyond). However, litigation and legislative actions are too new to be represented as a mandate which will guarantee education from birth for infants with severe and multiple handicapping conditions. The conceptualization of some of the prototype telecommunications systems has been predicated on the anticipated demand for infant learning programs, and systems are being designed to provide direct instruction to infants and to assist parents with the task of maintaining their child at home and in the community. The immediate goals for these systems are to demonstrate that it is possible to communicate with remote stations from a central computer system via telephone transmission lines and that computer technology can be employed effectively by parents and professionals to shape or build a behavioral repertoire in a severely impaired infant, utilizing systematic, daily intervention continuously from birth through the early school years.

Factors which have led to the development of and funding for telecommunications systems have been described. The immediate general goals for technology-based telecommunications systems have been stated. The activities required to meet these goals will be carried out and initial support will have been terminated by July 1976. Shortly thereafter, project reports will be available and the effectiveness of the systems will be open to public scrutiny. Those results will reflect short-term effects; the potential for the technology-based telecommunications systems will emerge when they are viewed with respect to their utility in long range instructional research and curriculum development efforts.

Their application to the development of automated sequential curriculum for infants and young children will emerge as a primary function. Why that should be done, and how it will be accomplished, will emerge in the next section, which sets the stage for a description of what the projects propose to do *now*. That will be followed by a description of what they may do in the future.

The basis for early intervention through telecommunications systems

The immediate function of the prototype systems has been defined: to provide a variety of educational interventions for existing populations which are heterogeneous in age and level of development. For the most part, these interventions are aimed at the modification of behavioral or intellectual defects of long term duration. The technologies may be applied more efficiently and effectively in the future to provide systematic instruction to children and support to parents, beginning at birth. Or, as Tawney (1975) noted, to develop model systems for the child of the year 2000.

The basic function of any intervention program is to facilitate or accelerate the course of normal development. Where severely handicapped infants are concerned, early intervention programs are designed to prevent retarded development which might be considered a function of observable biological defect, or inadequate environments (Bijou, 1966, p. 3). Here, biological events include sensory impairments, and environmental events refer to the stimulus-response interactions which retard development. Thus, from Bijou's (1966) framework, *a retarded individual is one who has a limited repertoire of behavior shaped by events that constitute his history* (p. 2). This formulation has proved extremely useful in the conceptualization of intervention programs. The task is clearly defined: to design environments which will shape or build a response repertoire (Tawney, 1974). Where severely handicapped infants are concerned, the environment will be the home, and family members will constitute the major class of stimulus events. For severely and multiply handicapped infants, pressure is mounting to develop programs which begin intervention shortly after birth. There is a growing body of literature that supports immediate intervention. Clues to the direction such interventions should take are drawn from the comparisons of structured vs. non-structured preschool programs. And, within the literature on the experimental analysis of behavior, there are precedents for the design of programmed or prosthetic environments. The potential of the telecommunications system appears greatest as a component of a prosthetic environment, where it is used to deliver instruction to infants and young children on a daily basis, to build or shape a "normal" repertoire through fine grain sequences of instruction. At the same time, the technology creates a service delivery system which can be used to assist parents with the task of facilitating the development of their child.

Support for intervention originating shortly after birth can be found in enabling legislation, BEH priorities for early childhood education, the development of an early education network for preschool education for the handicapped, set-asides in Head Start funding to insure service to the handicapped, and the initiation of research and demonstration programs designed to insure enrollment of children in preschool and day care programs. The empirical basis for early and systematic intervention is fragile but is growing with the accumulation of evidence which suggests that infant behavior can be modified. White (1971), for example, has reported selected studies from his long term program of research with normal infants. Recent studies in infant learning have been reviewed by Fitzgerald and Porges (1971) and Hulsebus (1973). These excellent reviews suggest that infant instruction is feasible and, in addition, offer clues for the development of appropriate learning tasks. The empirical basis for long term intervention with handicapped infants and young children is sparse. However, research efforts such as the recently completed Toddler Research and Intervention Project (Bricker and Bricker, 1972) should provide a rationale for early intervention as data become widely distributed. The long term, ongoing intervention program for Down's children (Hayden and Haring, in press) provides strong support for early intervention. After five years of intervention with infant learning programs, parent training and support programs, and continuous sequential instruction, Down's children are entering first grade classes with "normal" children. The academic performance of these children refutes the assumption that Down's children are low functioning. Hopefully, the performance of these children will stimulate special educators to examine the assumptions they hold concerning the potential of all handicapped persons.

The experience in the growth of preschool programs for the disadvantaged suggests the directions that infant learning programs are likely to take, in terms of structured vs. non-structured programs. Early childhood studies (Karnes, et al, 1968) which demonstrate the positive outcomes of direct instruction, indicate the direction which infant programs might follow. Basic approaches to education for severely handicapped infants will emerge with time. Lambie, Bond, and Weikart (undated) have described three types of curricular approaches for the normal infant: programmed, open framework, and learner-centered. The behavioral characteristics of severely handicapped infants suggest that the programmed approach may hold much promise. This view is supported by the positive results which are generally supported in the literature of the experimental analysis of behavior. In contrast to the results of large, experimental studies conducted by special educators to test the "efficiency" of special education practices, this literature contains successful demonstrations of the application of fine grained programming techniques to shape academic and social behaviors. Of particular interest are studies which utilize an errorless learning paradigm to shape complex discriminations (Bijou, 1968; Sidman and Stoddard, 1966; Tawney, 1972; Terrace, 1967).

This methodology has been applied to instructional programming for children with severe developmental retardation (Tawney, et al, 1975). The methodology (precise control of environmental events, carefully sequenced instructional steps, immediate and contingent reinforcement of correct responses, arrangement of stimulus presentations to reduce the probability of error) can be applied to the development of instructional programs for infants. Telecommunications systems which utilize home-based computer terminals have the capacity to deliver "errorless" curricula to home settings. The characteristics of prototype systems, described in the next section, illustrate present capacity to provide instructional programming. Later sections describe the function of telecommunications in broadly based alternative educational delivery systems.

FIVE PROTOTYPE TELECOMMUNICATIONS SYSTEMS

The Utah Project

The Exceptional Child Center at Utah State University is establishing a Homebound Handicapped Resource Center as a major component of their telecommunications project. The goal of the project is to serve children in rural areas who are considered severely and profoundly retarded, multi-handicapped, or emotionally disturbed.

The telecommunications network links the Resource Center, homes, a local homebound instruction teacher, and the Intermountain Medical Program, a health service unit, by standard telephones equipped with interactive speakers. Once identified, parents are sent instructional packages which are designed to assist them in teaching language, leisure time, arithmetic, and self-help skills to their children. The instructional packages are written specifically for parents and contain step-by-step instructions to teach skills such as counting objects, naming coins, number skills, and number symbols. They also contain instructions to enable parents to provide verbal assistance, to evaluate responses, and to correct errors.

The interactive telephone speaker system is used to report children's progress, to solve instructional or programming errors, and to assist parents in solving management problems. The system provides low-cost supplementary educational services to parents. The inclusion of the local homebound teacher and a regional health agency increases the base of supportive services to families who are geographically dispersed throughout a large, sparsely populated area.

The Teaching Resources Center Project

Teaching Resources Center at the City University of New York is developing a series of films to teach language concepts to children who are considered to be mentally retarded or who manifest severe behavior disorders. Tape vignettes feature puppets, similar to Sesame Street characters. The dialogue is written to teach and reinforce use of specific language concepts.

Programs are presented on a responsive TV system -- a standard television set which has been modified by the addition of an electronic switching device. For this application, a four button response system is connected to the switching device. Each button contains a picture of one of four puppet characters featured in the video-tape lessons.

Each video lesson is programmed to present a single concept, then to test children's knowledge of the concept. After each episode, the characters direct the child to press a specific button to register a discriminative response. A correct response produces an appropriate confirmation/reinforcement from the character. An incorrect response produces corrective feedback from the character whose button is pressed.

This telecommunication system is presently being used in research to test hypotheses related to television instruction. The video programs can be used over the air or on cable systems. The instrumentation required to convert a standard TV to a responsive system appears to be uncomplicated and will perhaps gain wide usage.

The New York State Department Project

The New York State Department of Education at Albany has initiated a telecommunications project in the Buffalo area which will serve one hundred persons, primarily 5-21 years of age, whose physical handicaps are so severe that they are unable to attend public school classes.

Curriculum materials which are available commercially will be transmitted into homes via an interactive television system composed of cable TV and telephone transmission to communicate with the student. A teletype keyboard and acoustic coupler will be placed in the home and integrated with the families' existing television set, creating a CAI terminal.

The system is designed to work in the following manner: the student dials the computer center, places the telephone in the acoustic coupler, and types a message to the computer center on the teletype keyboard. His message will call up a specific instructional program or set of instructions, which will be transmitted over the cable TV system and appear on his television set. His response will call up a program change and the computer-student interaction will continue until the lesson is completed. The computer control system is designed around a Hewlett-Packard 2000F dual processor computer, modified by MITRE Corporation for use with their TICCIT system. Basically, the systems operate in the following manner: programs are stored in computer memory. When a specific program is called up, computer signals are generated, fed into the TICCIT system, and transformed into a TV signal which is transmitted over a cable network. The visual display appears on the television set in the home.

A wide range of curriculum programs will be available to users of the system. One set of materials includes reading and language arts programs appropriate for grades 3-6, as well as secondary programs in language, English, reading, arithmetic, and GED preparation skills. Another set contains approximately 350 individual lessons appropriate for all elementary grades, generally known as the Palo Alto materials. A third set of materials is appropriate for secondary level students and includes arithmetic drill and practice and simulation games. This set contains contributed materials prepared by computer users and distributed by the computer manufacturer.

This project will serve approximately one hundred families during its development phase and can provide different programs to ten homes simultaneously. The range of programs will provide individualized instruction and extensive data recording and storing capacity.

The Purdue University Project

The Purdue University Achievement Center for Children has initiated a project which utilizes two television transmission systems to deliver videotape programs to homes of fifty children labeled either severely or profoundly retarded, cerebral palsied and/or physically handicapped, and seriously emotionally disturbed, from birth through three years of age. Robert Currie, the director, and his associates are producing a series of eighty half-hour video-tapes designed to teach specific developmental skills.

Professional quality video-tapes are designed to provide illustrations of three methods for teaching a discrete behavior. A professional actor introduces each tape and carries on an informal dialogue directed toward the parent. A parent trainer demonstrates teaching techniques to a handicapped child, then assists the child's parent as she uses the same techniques. The informal style of the narrator and the use of a living room set establish a relaxed, nondirective instructional format. When the programs are complete, they will be transmitted into homes by mid-band cable TV or ITFS systems. During the term of the project, the fifty children in the target population will be identified and assessed by Achievement Center personnel. Equipment will be placed in their homes to enable families to receive programs. Instruction will be available to parents four hours per week for a forty week period. Parents will receive a TV schedule indicating when programs specific to their child's needs will be shown. Each broadcast period will last approximately one hour. After the video-tape is shown, parents will interact through a telephone link to the studio. Professional staff will be present to answer parents' questions and to provide additional suggestions. Since many families may be using the same programs simultaneously, parents will have the opportunity to hear each others' questions and concerns. Children's growth will be evaluated during the project and compared to a control group which does not receive instruction.

The University of Kentucky Project

For three years, Tawney (1972) has been involved in the design and implementation of technology in a preschool for children with severe developmental retardation. An INTERACT computer system (BRS/LVE), integrated with solid state equipment, has been used to develop hardware and software for automated teaching programs. The telecommunications project at the University of Kentucky is an extension of ongoing research and development activities initiated by the earlier project, Programmed Environments for the Developmentally Retarded. The goal of the telecommunications project is to design a system which will deliver direct instruction to infants and young children in their home environments. The first objective of the system was to develop a prototype unit which would enable signals generated by the INTERACT system to be transmitted over telephone lines to instructional devices in home settings. The second objective is to determine that these devices can work reliably for extended periods of time, while they provide instruction to children. When completed, this will be the first application of direct computer-generated instruction to remote terminals which are individually designed to register simple responses to complex stimulus presentations. Thus, the Kentucky project is a techonology demonstration whose product will be a replicable system with a wide range of applications.

The components of the system are an INTERACT computer, signal transformation units which convert electronic signals to audio signals, acoustic coupling devices, and a WATS telephone hook-up.

The INTERACT system consists of a Data General Nova 1200 mini-computer which has been modified by BRS to operate with ACT (Automated Contingency Translator), a language designed for the Behavioral Sciences. ACT programs are written in a natural language which is translated into a machine language by the INTERACT system. It can be learned rapidly by a person with little expertise in computer programming, an attribute which makes it especially attractive for educational applications. The first major efforts have been the design and testing of a prototype device (presently called a parallel-to-series unit) which enables the computer signal to be transformed to an auditory signal which can be transmitted over a telephone line. Each unit has two components. One is placed between the computer and the modem which connects to the telephone line, and the other is placed between the acoustic coupler and the teaching machine in the home. An electronic signal is transformed into an audio signal at one end and converted back to its original form at the other. The learning devices which are placed in the homes range from an automated crib to a teaching machine console which can present and record responses to reading comprehension programs. Presently, the telecommunications system is linked to the state WATS system through the University access lines.

Eighteen families will be served during the second year of the project. They will have access to six lines at the computer so that six children can receive instruction simultaneously for two hours per day, for approximately 250 days. Sequential curricular programs will be designed by a home liaison coordinator and carried out in cooperation with parents.

THE DESIGN AND FUNCTIONS OF A MODEL TELECOMMUNICATIONS SYSTEM

The birth of an infant with observable and multiple handicapping conditions signals an immediate change in the life cycle of a family unit. The number, type, severity, and incontrovertible presence of handicapping conditions is in direct proportion to the number, type, and duration of contacts the family will have with health, educational, and social service agencies.

Social commitments to home rearing and community services mandate new service delivery models. Preliminary evidence from early intervention programs suggests that it is desirable to begin educational intervention within a few days of birth and maintain daily, systematic, and sequential curriculum programming continuously through and perhaps beyond the normal schooling period. The nature of handicapping conditions and a presumed range of parents' adaptive behavior dictates that families will come into contact with numerous social agencies as their child matures. The use of technology to assist parents to aid and educate children is assured by the development of the telecommunications described in an earlier section. The specific function of each of these projects has been described. The purpose of this section is to describe the functions which a composite, model telecommunications system might perform during the first years in the life of a person with severe and multiple handicapping conditions. The basic functions include the use of technology to assist parents to teach their children, to provide direct instruction to children from birth into the early school years, and to assist parents with the additional child rearing demands by coordinating communication with and arranging interventions from the appropriate service agencies. The implications for comprehensive data collection will become apparent and will be discussed in the final section of this chapter.

Components of a model center

Facilities

The Kentucky telecommunications system will be utilized as the most direct reference for the model, designated simply as the Center, and located on a major university campus. The location provides access to the resources of the university, particularly medical services which receive damaged infants for emergency treatment.

Instrumentation

The instrumentation component of the center is composed of a mini-computer system which is linked by telephone and/or television transmission to homes of handicapped persons geographically dispersed across a service area. Control systems, such as INTERACT and TICCIT, integrated to function as independent combined systems, will generate a wide variety of signals or displays. An extensive library of software programs will be available to generate instructions from simple discrimination training to preacademic and academic instruction, including regular elementary and secondary curricula.

Banks of signal transformation or modulation devices will link the computer systems to the appropriate transmission system. A linkup between the campus computer system will permit data transmission for permanent storage in the larger system. The Center may also be linked to other centers across the country, as computer-to-transmission coupling devices, e.g. the Kentucky parallel-to-series units, move from prototypes to full production systems.

An extensive inventory of television equipment will complete the instrumentation for the Center. Specialty equipment, e.g. TICCIT computer-to-cable signal generator/transformers, video-tape recorders, and portable TV units, will send video-taped information into homes and enable field coordinators to obtain video data on child or family performance in the home. Where cable transmission is not feasible and over-the-air transmission is inadequate, loaner video-tape recorders may be placed in homes to transmit certain information to parents. The Purdue tape series represents an excellent example of material that might be presented in the home by loaner equipment.

In addition to the instrumentation, the Center will also contain a workshop where individually designed hardware units such as automated cribs and teaching machines are stored or built. This unit might also be responsible for the design and fitting of prosthetic devices for handicapped persons. If devices are available to families on a loan basis, and if they can be modified simply, it may be appropriate for such a unit to develop a "lending inventory", particularly since devices for young children are used for short periods and then outgrown.

Staff

At a minimum, a Center may be staffed with two people: a field liaison coordinator and a computer/educational programmer. The coordinator's major responsibilities are monitoring children's educational programs and initiating liaison with appropriate service agencies. The programmer's responsibilities include generation of appropriate programs and collection and treatment of the data which those programs produce.

An expanded staffing pattern is entirely contingent upon the financial support base for the Center, the number of children served, the rate of increase in population served per year, and the number of ancillary research and demonstration activities conducted in conjunction with the delivery of services. In short order, it is easy to consider the addition of administrative and secretarial staff, a research coordinator, a full-time social services coordinator, data analysts, hardware design and construction staff, equipment maintenance technicians, a curriculum development specialist (especially critical in the area of infant learning), and additional field coordinators in multiples of n children served. Cost effectiveness data will, of course, be a deciding factor in staffing a Center. It is sufficient here to note that direct service costs must be separated from total costs, to determine cost per unit of instruction and other relevant data.

Transmission Systems

Telephone, television, and satellite systems may eventually link the Center with remote (home) sites. Any home may be furnished with specially designed equipment to communicate through one or all systems. The Kentucky system permits voice or computer communication over telephone lines. The Albany project requires both television and telephone transmission to and from the home. In some cases, transmission over bands of a given frequency range will require adaptors for home television sets. These modifications, in a sense, provide the family with their "personal" station or channel, to view material that is specific to their interests.

Home-placed receiving systems

The basic task which confronts Center staff is to identify the least obtrusive site for a learning station in the home. The decision is relatively clear-cut if the person is a newly born infant with a room of his own. The task is more complex if the child is one of several children living in a two room house up a hollow in the heart of Appalachia. Data phones, electronic/audio signal converters, special television antennae, and television set converters will be installed in locations where the child will receive instruction. Then appropriate instructional devices, e.g. teaching machines, response panels, touch telephone or teletype keyboards, will be placed in the designated learning environment. Where possible, a learning carrel may be built to insure that instructional sessions can be conducted with a minimum of disruption to the learner or interruption of family routine. Center staff will supervise placement of the appropriate learning devices in the home and arrange for different devices to be built or installed as the learner develops. Center staff may also recommend modifications of the home environment to reduce architectural barriers and to insure maximum mobility within the home.

Service functions of the Center

The location, history, and public information systems of a telecommunications Center should insure that every newborn with observable and multiple handicapping conditions who resides within the service region is referred within a few hours of birth. This referral will initiate a sequence of interventions by the Center. The functions which the Center is likely to perform are described in the following hypothetical example. The infant may be presumed to manifest observable biological defect and multiple handicapping conditions. Without intervention, by school age, under traditional labeling practices, the child might likely be considered severely developmentally retarded, with physical impairments in locomotion, vision, or hearing. The infant's parents are likely to be poor, located in an area which is geographically separated from access to social services, to be relatively uneducated, and to have managed the rearing of other children with at least a marginal degree of success. If they have not yet become known to one or more service agencies, the birth of their handicapped child will target them immediately.

The functions of the Center may be generally classified as inter-agency liaison and coordination, direct instruction, parent training and support, and information collection. Subsequent to the referral, Center staff's first functions will be to enter the infant and family in a registry, to determine if a prior history exists with regional service agencies, and to inform appropriate agencies that the family may be prospective service consumers. These activities should be carried out with procedures and safeguards recommended by the participants in the Project on Classification of Exceptional Children, reported by Hobbs (1975, pp. 222-283). Contact with the family will be initiated while the mother and child are in the hospital. Parent support services may be initiated in the home prior to the infant's arrival, in those instances where extended hospitalization is required. The general objectives of Center staff during this period should be to alert agencies to potential requests for services, to provide technical and personal support to parents, to teach parents child care skills determined by specific health problems, and to develop a basic set of requirements for the first component of a learning environment within the home. These objectives should reduce the impact of the handicapped child on the family and prepare a support base for a positive learning environment.

Direct instruction -- child and parents

When Center staff have obtained extensive information on the infant, the home setting, and the parents' child rearing abilities, a first set of intervention strategies will be written. Then, Center liaison programming and environmental design staff will enter the home to prepare for the installation of the telecommunications linkage systems. The location of the learning environment will be determined and the first components will be constructed. In this instance, the infant is likely to be a few days or weeks old and the first learning environment will be his crib. The general objectives for this set of functions are to link the home to the Center by the appropriate set of communication systems, and to design and install the learning environment.

Several types of instructional functions will be initiated simultaneously. Parents must be taught to use the instrumentation and may require instruction in general child rearing practices as well as specific health-related practices. A sequential instructional program will be written for the infant, and parents may receive specific training when the program calls for parent-child-apparatus interaction. If, for example, the infant showed significant lack of tone or development in the leg muscles, the specific instructional objective would be to strengthen muscle tone using a kick panel crib device and parent reinforcement, contingent upon a computer-generated cue signifying that leg thrust of a specific force had been recorded. The field coordinator would state and describe the rationale for the program to the parents and teach the following skills to enable them to operate the instrumentation:

1. turn the apparatus *on*;
2. if necessary, wait *n* minutes until a *ready* signal appears;
3. place the panel in the crib and set the force adjustment to a predetermined number;
4. dial the Center;
5. wait for the appropriate signal;

6. place the telephone in the acoustic coupler for telephone line transmission.

To participate in the instructional program, the parent might be required to:

1. assist the child to make the first set of responses by gently placing its feet against the panel and pressing;

2. reinforce the child with a social response (tummy rubbing, talking, patting) when a computer signal indicates a correct response (made with n units of force).

The instructional function is, obviously, the most constant activity of the Center. The field liaison personnel will write short and long range programs for children in the areas of language, self-help, motor, concept, and social development. The coordinator, in cooperation with the Center-based computer programmer and instrumentation design staff, will write balanced educational programs that insure the continued development of the child throughout the early years. As the child matures, instrumentation will be changed, the learning environment will be modified, and prosthetic devices may come and go. When combinations of handicapping conditions necessitate complex instructional programming, Center staff will be able to call upon consultant resources to assist with program writing. The structure and function of the Center, as noted, is based on service to a low incidence, difficult to manage, geographically dispersed population. This presumes that day care, preschool, kindergarten, and early public school programs will not be readily available to the handicapped child. Where they are, however, Center staff will be responsible to see that the child has access to these programs and may arrange to install learning environments in these settings.

Inter-agency liaison and coordination

The inter-agency liaison and coordination functions of the Center may be performed continuously through the life of a severely handicapped person. Initial contacts with health and social service agencies will establish a basis for an ongoing communication network. In the case of a marginally adaptive family unit, as in our example, it is likely that the Center may orchestrate interventions by each agency in the Center's service area. After the birth of the infant, first coordination efforts are likely to be with health-related agencies. Infants may require repeated hospitalization or a special health care regimen in the home. Center staff's extensive involvement during this period will enable them to observe significant changes in the infant's condition, to assist parents in maintaining a specific requirement, or to alert professionals if the family does not carry out recommended procedures. Diagnoses of infant's functional abilities in vision and hearing may remain tentative for an extended period. Center staff may assist parents in obtaining repeated assessment from those few agencies that have the requisite personnel and instrumentation to conduct valid assessments. When Center staff receive the results of these assessments, they may incorporate them into instructional programming changes and transmit results to other agencies; the Center will receive their progress reports and consult with their personnel to insure correspondence among concurrent training programs. Home maintenance of the infant may require significant adjustments in the personal health and nutritional habits of the family. When it is evident that public health intervention is required, Center staff may informally monitor the extent to which new techniques are used and alert public health personnel to increase or reduce intervention. This function has the potential to increase the efficiency and effectiveness of such interventions and can contribute to more effective manpower utilization.

The marginally adaptive family may require additional financial support to maintain their child in the home. Center staff may assist them in contacting appropriate welfare or social service agencies to determine the types of existing support systems. Providing access to such resources may require coordination and information sharing with legal aid societies and advocacy groups. The Center will maintain a listing of procedures for obtaining financial support to purchase or lease special prosthetic or instructional devices, in much the same way that parents of the blind child might presently obtain a Brailler, an Optacon, or other materials.

Finally, Center staff will be able to monitor the family's ability to maintain the infant in the home. All of the listed functions are directed toward that goal, and it is presumed that the suggested interventions will be sufficient to enable the family to raise their child. To increase the probability that they do, Center staff may encourage them to seek support from mental health clinics and parent support groups. Where respite care services are available, Center staff may assist families in utilizing them. Where they are not available, staff may be instrumental in assisting other agencies to establish them. If it becomes apparent that massive support is insufficient to maintain the home placement, the Center's information base and extensive interaction with the family will enable them to assist other agencies in obtaining a foster home placement in the community. Although the parents may not be able to manage the child on a daily basis, the Center can insure that the first move out of the home is a short one and that sustained efforts are made to reduce the probability of institutionalization.

Information Collection

The education and liaison functions of the Center will generate a comprehensive data base on each family unit. The major portion of the data will be daily records of the child's performance on instructional tasks. Responses to automated curricular tasks will be received and recorded fifty milliseconds after they are emitted. In many instances, the first function of the data will be to signal an automatic, on-line change in the academic program. In other instances, programmers may modify a program after an instructional session has been completed. Parents and the field coordinator may enter the results of non-automated programs, either through the computer system or by regular telephone transmission. Similarly, physical therapists and others who intervene in the home will transmit a record of child performance to the Center. The daily record will be transferred to permanent storage to become part of a comprehensive cumulative record of each child's educational history. It will be possible to call out data summaries on all, or a portion of, the child's record. These summaries will be helpful in the development of long range educational programs. The summaries will document what and how well a child has learned over a period of time -- information which is critical at this point in history, when few hold a positive view of the potential of the child with severe and multiple handicapping conditions. The liaison function of the Center will generate a complete history of the family's contacts with service agencies. Kept in a central location and used as a reference by appropriate agencies, these records will contribute significantly to interagency communication and coordination of effort.

This brief description of the multiple functions of the Center clearly emphasizes the unit's role as the primary educational agent from birth to an undefined point in adulthood. At the same time, the description of liaison and coordination functions gives a brief glimpse of the potential of a central agency which serves as a clearinghouse for all social service agencies. The comprehensive data base, coded for confidentiality and monitored continuously, provides a foundation for a level of coordinated service delivery which is unparalleled in history.

The examples and activities have been described in the future tense, which tends to give them a third world reality. However, certain functions will be initiated on the Kentucky telecommunications project before this chapter appears in print. Whether the project can be transformed into a model Center remains to be seen, but the critical decisions to affect that transformation will have been made before this book is widely distributed. Thus, hypothetical examples will become reality in a relatively short period of time. The integration of technologies, a next logical step, will expand the scope of planned activities. As the Center concept develops, the nature of service delivery systems will be altered drastically. The Center may become a significant factor in radical change of service delivery patterns and will obviously become a critical factor in the lives of the families it serves. Not entirely by coincidence, the Center has the potential to affect some of the reforms recommended by HEW's Project on Classification of Exceptional Children, namely that:

> "The public schools should be the institution with the primary advocacy responsibility for providing or obtaining educational and related services for all children in need of special assistance whose condition or life circumstance does not require their institutionalization."
> (p. 250)

> "Funds should be made available to public schools to provide educational or developmental services to handicapped children and youth from birth through the school years . . . " (p. 251)

> " . . . educational programs for handicapped children be carried out in as near to normal settings as is consonant with the provision of specialized services they need."
> (Hobbs, 1975)

SYSTEMS OF THE FUTURE

Combining prototype systems

The telecommunications systems described here are prototypes, by and large. Once it is determined that they work, it will be necessary to determine whether they work reliably, whether they are utilized to the maximum, whether they produce desired changes in behavior, and whether they do so in a cost-effective manner. As these questions are answered, the systems and their products will undoubtedly be used in different combinations and with yet-to-be-conceived technologies.

The teaching packages prepared at the University of Utah are widely exportable and potentially useful in a variety of educational settings. The content of the video language instruction tapes developed in New York City will make them useful, whether transmitted with the responsive TV system or modified for standard presentation. The Purdue University parent training tapes, likewise, will undoubtedly find their way into university training programs, family health care units, etc. The hardware and slide programs developed at the University of Kentucky are adaptable for other instructional environments.

The potential of television as an instructional medium seems assured, regardless of the rate of development of specific systems. Cable networks may or may not expand into every area of the country, and may or may not be heavily subscribed. Where cable TV is available, it may be necessary to subsidize cable payments to families to provide access to home training materials. Or, as television equipment costs drop, it may be reasonable to provide state grant support to enable parents to purchase video-tape recorders. The cost per unit, figured on a daily use basis, for five or ten years, will be minimal. Tape lending libraries, equipped with facilities for duplicating master tapes onto reusable tapes, can provide large numbers of users with the same material, sent by mail or delivered by a home liaison coordinator. As the cost of small portable video recording units decreases (and when their reliability increases), it will be possible for home liaison personnel to obtain permanent records of parent-child interaction and child response to automated programs. These permanent records may be useful for study by researchers or other interventionists.

Presently, computer systems such as INTERACT and TICCIT are constrained by the unique design characteristics of same-generation computer systems. Programs designed for one computer cannot be used on another without extensive and costly modifications. This problem will be reduced as minicomputer users expand and share software packages. Most computer manufacturers encourage and support the activities of user groups. These groups will undoubtedly grow in size and originality, increasing communications among users and accelerating the development of novel applications of standard programs. The products of these groups will expand the curricular offerings of the projects described here. As noted, a portion of the Albany library comes from this source.

Present design restraints may make it possible to combine systems like INTERACT and TICCIT so that one minicomputer can drive both systems in succession. It is reasonable to assume that both systems will be used side by side in a model Center, similar to that described in an earlier section. When the first attempt is made to integrate the two systems, the resulting engineering changes are likely to standardize the components on the independent systems.

The technologies described here are relatively earthbound. They may, however, be combined with projects which have been initiated to test application of satellite transmission to satellite communications systems which have been under development for the past several years. As the space program has decelerated, NASA has initiated programs to determine the feasibility of earth-satellite-earth communications. Major programs have been initiated in the Rocky Mountain states and in Appalachia. Educational programs may be beamed to a satellite to multiple sites within the "satellite footprint". In some instances, relatively low cost antennae enable audiences to receive television signals. In other instances, more expensive send-receive units are placed in a central location; these interactive units enable a large audience to communicate with professionals at the television studio subsequent to and even during broadcast. It is too early to tell whether the satellite projects will be cost-effective or whether they can generate sufficient simultaneous broadcasts to serve the many educational needs of the inhabitants of the sparsely populated or geographically remote areas they were designed to serve. In the event that they receive continued support, the program content developed on the telecommunications projects can be transmitted via satellite. At the same time, the programming content they have developed for specific audiences may be added to the tape libraries for the telecommunications projects.

Our society has entered an era of rapid technological development, where today's innovation may be outmoded tomorrow. The telecommunications technologies represent new and exciting ways to deliver instruction to children. Although they may become obsolete within ten years, they will initiate changes in instructional models which will remain after they have been replaced by more advanced technologies.

Future manpower requirements

When the opportunity is presented to engage in a bit of futurism, there is temptation to speculate at length on the potential of technology to create a demand for new types of personnel and to open up new areas of research. There is a tendency to obscure the difference between what is possible with the advent of the prototype telecommunications projects and what may be possible with a technology-based Center delivery system. It is apparent, particularly with respect to the Center concept, that speculation proceeds on a variety of assumptions about the way the world ought to work, rather than how it does. These cautions notwithstanding, the prototypes have the potential to bring about significant change in the lives of families. To do so will require personnel with new sets of competencies and will open up areas of research which have been logistically impossible in the past.

The Kentucky telecommunications project will create the most immediate need for personnel with different sets of competencies. A home liaison coordinator will need to be skilled in:

- parent training
- curriculum development
- infant learning and development
- operation of instrumentation
- inter-agency liaison tasks

An educational/computer programmer will need to be skilled in:

- computer programming
- writing software programs
- writing long-term instructional programs
- data reduction and analysis
- reporting child performance

By themselves, these are not new competencies. Taken together, they represent unique job descriptions which few persons are qualified to fill. As technologies are combined to provide long-term and extensive services, additional functions, e.g. social service referrals and follow-up, child family advocacy, will be added to these basic positions.

FUTURE DIRECTIONS FOR CURRICULUM AND PROGRAMMATIC RESEARCH DEVELOPMENT

The discussion of infant learning tasks would lead one to the assumption that valid curricula do exist, sufficient in scope to cover the age range from birth to approximately six years of age. The Kentucky and Purdue projects represent approximations to the comprehensive, sequential curricula. One of the highest priorities for research and development is the design of a total curriculum for infants with severe and multiple handicapping conditions. The prototype telecommunications systems are, from one perspective, more sophisticated than the curricula they deliver. It is possible to deliver instructional signals and record responses in a fraction of a second. On selected learning tasks, simple branching is possible. What is lacking is identification of valid learning tasks and the development of fine grain instructional sequences. The literature on infant learning offers some direction for the curriculum developer. A limited number of infant training programs have been published and there are a few "stimulation" programs in progress at this moment. These will form the working material for, but should not be confused with, a complete, systematic, sequential, and fine grain infant curriculum. Such curriculum may require ten to fifteen years of development and validation. While present technology is sufficient to initiate the task, future developments may accelerate its completion.

Little is known about the early development of the handicapped infant, or of the normal infant either for that matter. The literature on infant learning is sprinkled with comments on the logistical problems which face the researcher. Consequently, empirical studies of infant behavior are often based on short-term observations. The advent of the telecommunications systems will remove many of the barriers which have hampered programmatic research efforts. Home-placed computer terminals and long-term Center contact with families should guarantee access to a population and enable researchers to obtain data from homes on a daily basis. Research priorities are likely to be addressed to two general questions: "What does the severely handicapped infant do (e.g. how does he behave) when he enters his home environment?" and "How do families behave when they return home from the hospital with their handicapped infant?" Infant learning studies are likely to be integrated with, and form the empirical basis for, a valid, systematic curriculum. One general approach will be to determine the extent to which it is possible to shape or build a behavioral repertoire. The outcome will include a curriculum and a set of studies which describe the effects of specific intervention strategies.

Few have attempted to observe a family's response to a fragile and observably impaired infant. A Center-based telecommunications system, in contact with a family almost immediately after the birth of the impaired infant, will have the capacity to observe family-infant interactions and intervene to increase the quality and quantity of those interactions. With sufficient programming, it may be possible to identify and document those strategies which most effectively help parents maintain their child in the home. Comprehensive record systems collected on heterogeneous family units over long periods of time will contribute to more efficient and effective delivery of services. The growth of computerized telecommunications systems will provide an opportunity to observe the extent to which family units can incorporate an advanced technology into the daily patterns of home living. Computer systems are designed to assist, rather than supplant, parents, and are designed to perform multiple functions. They will be most effective when utilized to the maximum. The presence of these systems in homes, and projected use over a period of several years, will provide a fertile testing ground for the facilitation of man-machine interactions and, more specifically, infant-computer, family-computer, and parent-infant-computer interactions.

A final note is called for to emphasize the ordering of priorities for research with prototype telecommunications systems and proposed automated curriculum. As soon as a system has been conceptualized and designed, a natural first question is often, "Yes, but is it better than 'x' (anything else)?" There is a more logical set of questions which must be directed toward prototype systems, and it is important that policy makers, professionals, and parents learn to address first questions first. Viewing all the systems collectively, a general sequence might be:

- Does it work?
- Does it work reliably?
- Is the system cost-effective?
- What are the parameters for curricular presentations?
- How do parents, child, and system interact to carry out an instructional program?
- What are the "normal tasks of childhood?"
- What are valid instructional tasks from birth to six?
- How do infants respond to specific instructional tasks?
- Do severely retarded infants learn?
- Is this approach better than another?

In closing, it should be apparent from the length of the list that the first natural question must be preceded by a more logical set. In 1975, telecommunications systems appear to have the potential to produce significant change in the lives of handicapped infants and in the structure of future delivery systems. In some cases, it may require up to fifteen years of research and development to provide answers to each of the questions which are addressed here. It seems appropriate to end with a caution that consumers and consumer advocates address the proper questions in their logical sequence. Failure to do so will consign these innovative programs to the nation's junk heap of grandiose projects which have foundered on the shoals of underfunding and premature evaluation.

BIBLIOGRAPHY

Bijou, S. A functional analysis of retarded development. In N. Ellis (Ed.), *International review of research in mental retardation*, Vol. 1. New York: Academic Press, 1968, 1-19.

Bijou, S. Studies in experimental development of left-right concepts in retarded children using fading techniques. In N. Ellis (Ed.), *International review of research in mental retardation*, Vol. 3. New York: Academic Press, 1968, 66-96.

Bricker, W. and Bricker, D. Toddler Research and Intervention Project Report -- Year II. George Peabody College for Teachers, IMRID Monograph No. 21, 1972.

Children's Defense Fund, *Children out of school in America*. Cambridge, Mass., 1974.

Fitzgerald, H. and Porges, S. A decade of infant conditioning and learning research. *Merrill-Palmer Quarterly*, 1971, *17*, 79-117.

Hayden, A. and Haring, N. Programs for Down's syndrome children at the University of Washington. In T. Tjossem (Ed.), *Intervention strategies for risk infants and young children*. Baltimore, Maryland: University Park Press, in press.

Hobbs, N. *The futures of children*. San Francisco: Jossey-Bass, 1975.

Hulsebus, R. Operant conditioning of infant behavior: A review. In H. Reese (Ed.), *Advances in child development and behavior*. New York: Academic Press, 1971, 111-158.

Karnes, M., Hodgins, A., Stoneburner, R., Studley, W., and Teska, J. Effects of a highly structured program of language development on intellectual functioning and psycholinguistic development of culturally disadvantaged three-year-olds. *The Journal of Special Education*, Vol. 2, No. 4., 1968, 405-412.

Lambie, D., Bond, J., and Weikart, D. *Framework for infant education*. Ypsilanti, Michigan: High/Scope Educational Research Foundation, undated.

Sidman, M. and Stoddard, L. Programming perception and learning for retarded children. In N. Ellis (Ed.), *International review of research in mental retardation*, Vol. 2. New York: Academic Press, 1966, 151-208.

Tawney, J. Programmed Environments for Developmentally Retarded Children: A project for a coordinated program of research, program model development, and curriculum development and dissemination. Project No. 233118 (original proposal), 1972.

Tawney, J. Training letter discrimination in four-year-old children. *Journal of Applied Behavior Analysis*, 1972, Vol. 5, No. 4, 455-465.

Tawney, J. Programmed environments for the developmentally retarded. In P. Mann (Ed.), *Mainstream special education*. Washington, D.C.: Council for Exceptional Children, 1974.

Tawney, J., Allen, M., O'Reilly, C., Cobb, P., and Aeschleman, S. Developing curricula for errorless learning: A search for order in an unorderly world. *Selected Papers*: American Association for the Education of the Severely/Profoundly Handicapped, 1975.

Tawney, J. Prerequisite conditions for the establishment of educational programs for the severely retarded. Proceedings of the NARC conference on education for the severely retarded: National Association for Retarded Citizens, in press 1975.

Terrace, H. Stimulus control. In W. Honig (Ed.), *Operant behavior: Areas of research and application*. New York: Appleton-Century-Crofts, 1967, 271-344.

White, B. *Human infants*. Englewood Cliffs, New Jersey: Prentice-Hall, 1971.

APPENDIX B

MAJOR ACTIVITIES ASSOCIATED WITH TECHNOLOGICAL DEVELOPMENT

MAJOR ACTIVITIES ASSOCIATED WITH TECHNOLOGICAL DEVELOPMENT

Appendix B contains a chronological list of the major activities and their attendant problems which transpired during the technological development of the system. Entries in the problem column largely account for the delays and system failures. Minor problems such as equipment failure requiring maintenance (e.g., projector bulb burning out, relay malfunction) or occasional computer malfunction (e.g. loss of the ACT language), are not listed.

Data shown in Section Three suggests that major problems were solved and that it was possible to obtain reliable data transmission in the majority of sites. This information is included in the report to provide potential replication users with a general idea of problems likely to be encountered in technology development projects. Here, linking different systems multiplied the effects of problems within a single component of the system.

CHRONOLOGICAL LIST OF MAJOR ACTIVITIES ASSOCIATED WITH TECHNOLOGICAL DEVELOPMENT

DATE	ACTIVITY	PROBLEM	SOURCE	SOLUTION
June, 1974	Delay in Project start date	Funding date changed from June to July	BEH/Grants & Procurements Management	Whole contract period set back one month
July, 1974	Equipment delivery delayed	Delivery time lengthened from 90 - 120 days	undetermined	none
November 15, 1974	Equipment delivery delayed	Promised delivery date not met	BRS/LVE Electronics	calls made requesting delivery
December 1, 1974	Equipment delivery delayed	New promised delivery date not met	BRS/LVE Electronics	calls made requesting delivery
January 20, 1975	Prototype interface completed and tested by BRS/LVE	Modems not compatible with CBT used to test interface	Teledynamics specification error	BRS/LVE requested new CBT from phone company
January 28, 1975	Prototype interface delivered and tested at Telecommunications site	1. Interface would not link up with Telecommunications CBT 2. Transmitted signals not reassembled properly by modem interface	1.Teledynamics specification error 2. Internal heating of interface suspected	1. Call to Teledynamics identified problem 2. Prototype interface returned to factory for further development
February 10-16, 1975	Received and tested revised prototype interface	none	none	none

LIST OF MAJOR ACTIVITIES ASSOCIATED WITH DEVELOPMENT (continued)

DATE	ACTIVITY	PROBLEM	SOURCE	SOLUTION
February 17-23, 1975	Tested system with child at Programmed Environments Preschool	none	none	none
February 24-March 20, 1975	Installed and tested system with child at child's home in Lexington, Ky.	none	none	none
March 31, 1975	Installed and tested system at Henry Clay school in Louisville, Ky.	none	none	none
July 1 - August 15, '75	Construction of apparatus began	needed to observe children	none	site visits and evaluation of referrals
August 18-20, 1975	Tested production model modem interface	Interface clocks needed adjusting	characteristic of interface	pig-tail leads soldered onto each test point and resistor adjusted with aid of oscilloscope
September 4, 1975	First home installation completed	Data transmission persistently unreliable	Timing error and incompatibility of acoustic coupler and hard-wired modem	Teledynamics representative checked modems and diagnosed problem as incompatible modems (LC-3's ordered to replace LC-1's)

LIST OF MAJOR ACTIVITIES ASSOCIATED WITH DEVELOPMENT (continued)

DATE	ACTIVITY	PROBLEM	SOURCE	SOLUTION
November 12 - December 9, 1975	Tested new LC-3's	LC-3's linked up with original modem but not the other five	wiring error in original Teledynamics specifications	rewired modems and had telephone company rewire phone system
February 13, 1976	Added programs to computer station #3	Children's responses made on station #3 programs were not recorded accurately	2 printed circuit cards were defective	Defective cards were replaced and returned to BRS/LVE for repair
Feb. 15 - March 22, '76	continued daily running of children	persistent inaccurate data from sites in Somerset area	noise from telephone lines suspected	call to phone company resulted in check of trunk lines. No problems found but could have been defective feed line

APPENDIX C

OPERATION MANUAL

TELECOMMUNICATIONS
OPERATIONS
MANUAL

TELECOMMUNICATIONS PROJECT STAFF
114 Porter Building
730 South Limestone
Lexington, Kentucky 40506

NAME	PHONE NUMBER
Ms. Pat Cobb, Field Liaison	(606) 258-4716
Ms. Marilyn Gall, Social Worker	(606) 258-4716
Dr. James Cooley, Research Director	(606) 258-2815
Ms. Lilly Burns, Telecommunications Operator	(606) 258-2815

Call collect 8:00 a.m. - 5:00 p.m. (EST) Monday through Friday. Weekends and holidays call the field liaison collect at 606 - 266-4383.

INTRODUCTION

The purpose of this manual is to show how to operate the pieces of equipment that accompany the learning apparatus in the home.

This is only for the basic pieces of equipment. Since each learning apparatus is individually designed, any additional and/or different instructions are under separate cover.

PARTS AND THEIR FUNCTION

These are the separate parts of the whole set. They are talked about in the order that you will be operating them.

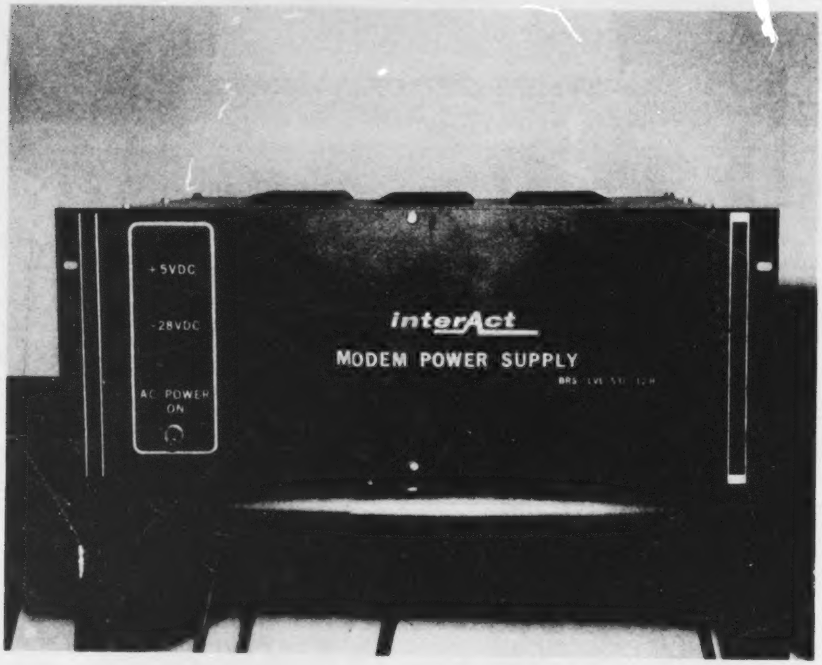

FIGURE 1

This is the MODEM POWER SUPPLY. The modem power supply furnishes the power for all of the equipment. It sits on the top of the Modem Interface. (See Fig. 2).

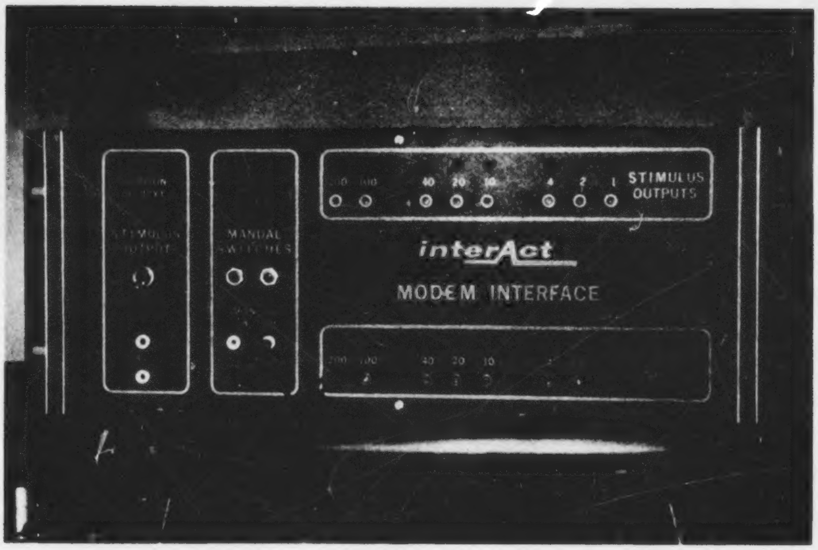
STIMULUS OUTPUTS
MANUAL SWITCHES
200 100 40 20 10 4 2 1
STIMULUS OUTPUTS
interAct
MODEM INTERFACE
200 100 40 20 10

FIGURE 2

This is the MODEM INTERFACE. It changes an audio signal to an electric signal which makes the equipment work.

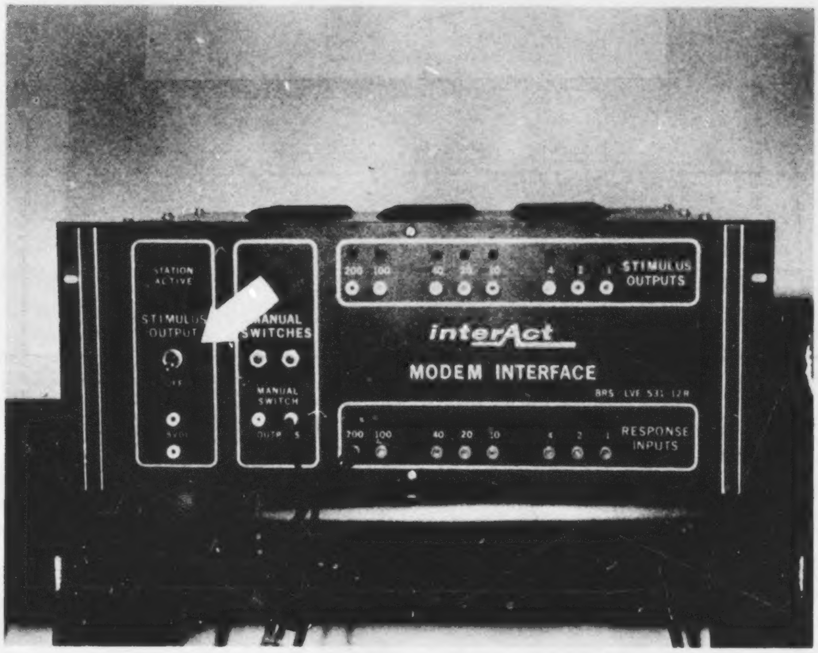
STATION ACTIVE
STIMULUS OUTPUT
MANUAL SWITCHES
MANUAL SWITCH
200 100 40 20 10 4 2 1
STIMULUS OUTPUTS
interAct
MODEM INTERFACE
200 100 40 20 10 4 2 1
RESPONSE INPUTS

FIGURE 3

Figure 3 shows the On/Off switch on the Modem Interface. ON is UP. This switch can be left in the ON position all the time.

162

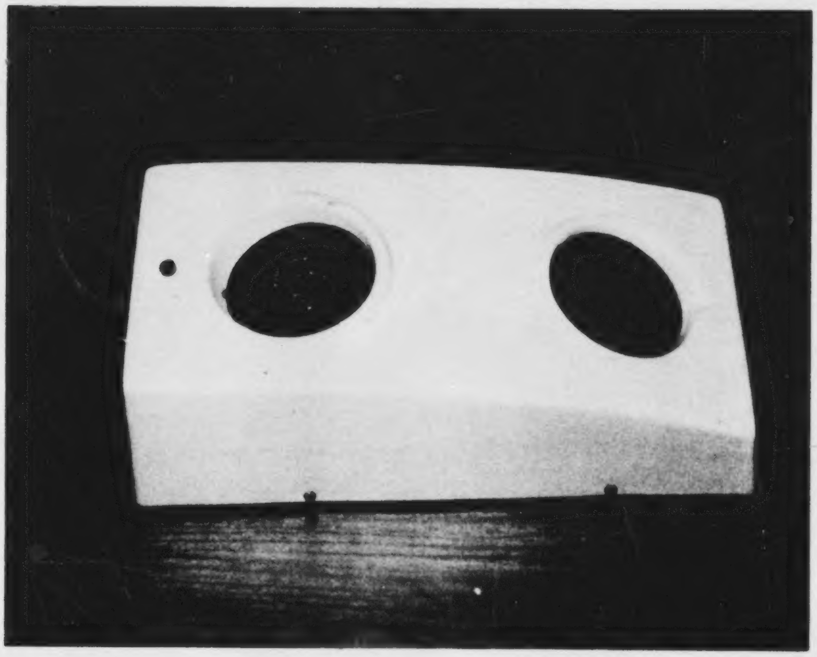

FIGURE 4

This is the ACOUSTICE COUPLER. The telephone handset goes in it. (See Fig. 5). The acoustic coupler links the telephone system to the teaching machine.

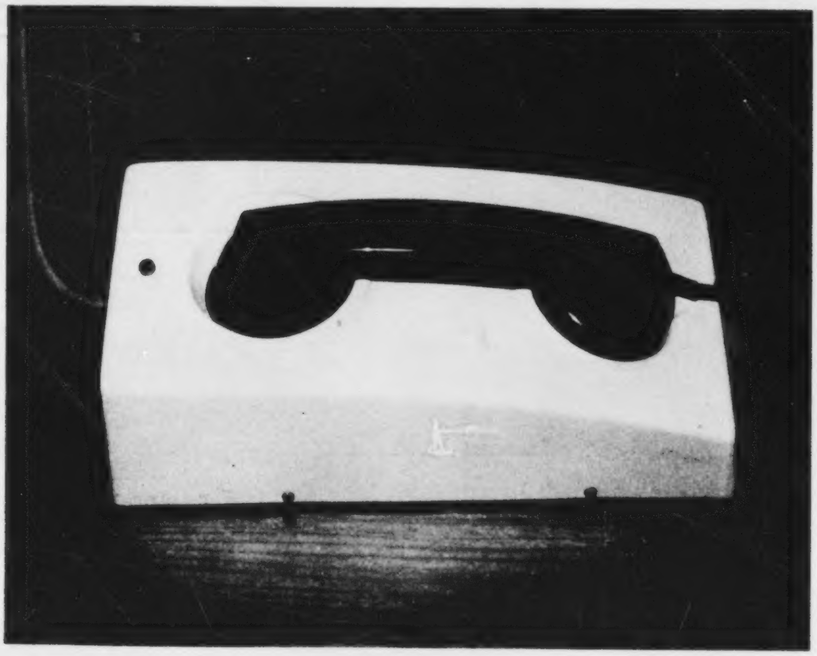

FIGURE 5

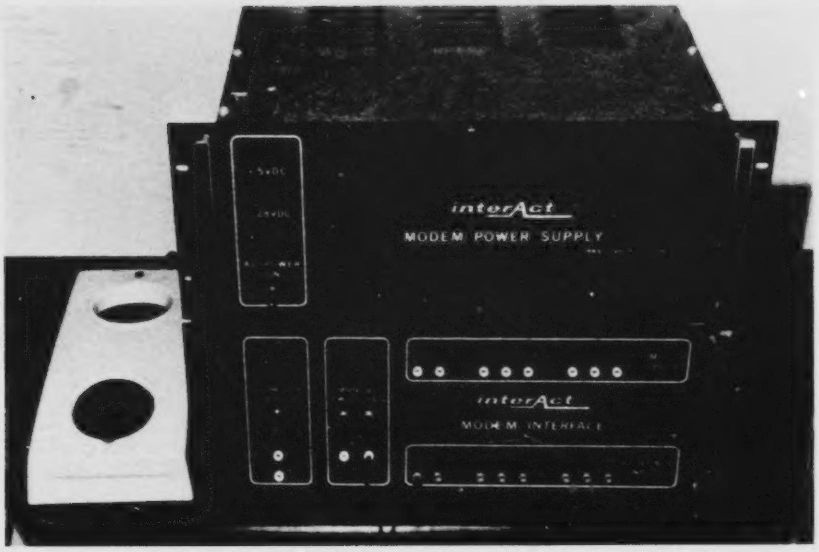

FIGURE 6

This is the whole unit set up as it is in your home.

POSITION OF SWITCHES

To make everything work, all switches and lights must be in the correct position and order. Please check them every day. You can use the following chart as a guide.

EQUIPMENT	CRITICAL SWITCH/LIGHT	CORRECT POSITION/TIME
Power Supply	on/off switch Fig. 7	turn ON 5 minutes before lesson
Modem Interface	on/off switch Fig. 3	leave ON all the time
Acoustic Coupler AND telephone handset	ANS switch Fig. 9 position of handset Fig. 10	ON if told to do so, all others OFF. cord in notch, earphone closest to orange light
Acoustic Coupler	Orange light Fig. 11	ON when telephone is in the coupler

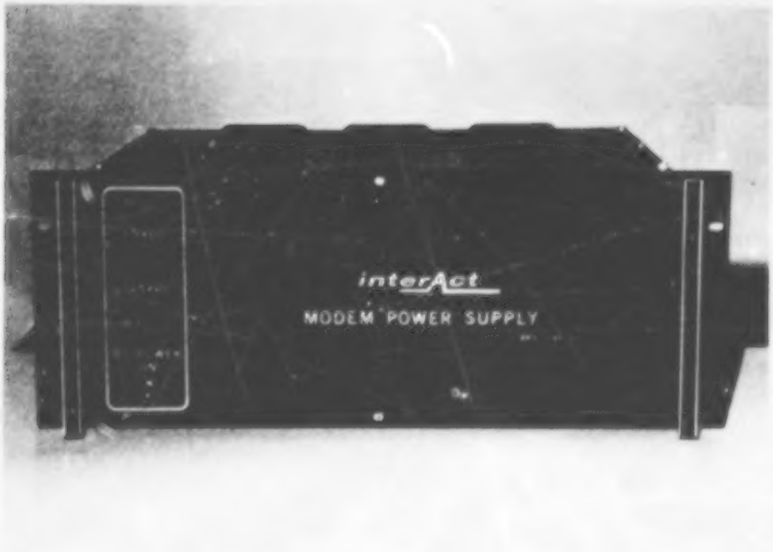
interAct
MODEM POWER SUPPLY

FIGURE 7

The MODEM POWER SUPPLY has one switch, which is to be turned ON five minutes before the scheduled time for the Telecommunications operator to call. ON is UP. The arrow in Figure 8 shows the ON/OFF switch.

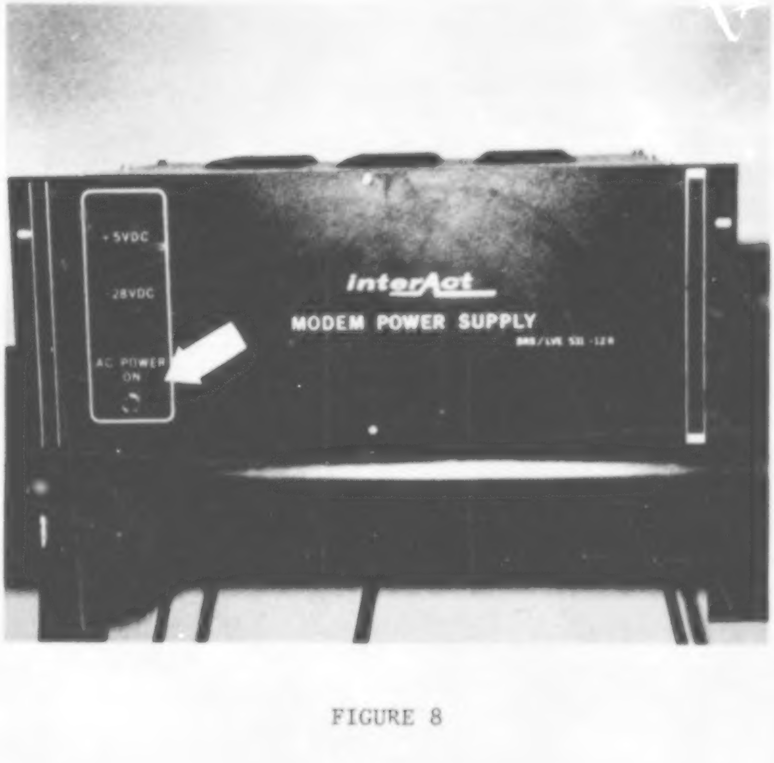
+5VDC
28VDC
AC POWER
ON
interAct
MODEM POWER SUPPLY

FIGURE 8

When the Telecommunications operator calls, talk to her first so she can evaluate the quality of the telephone connection.

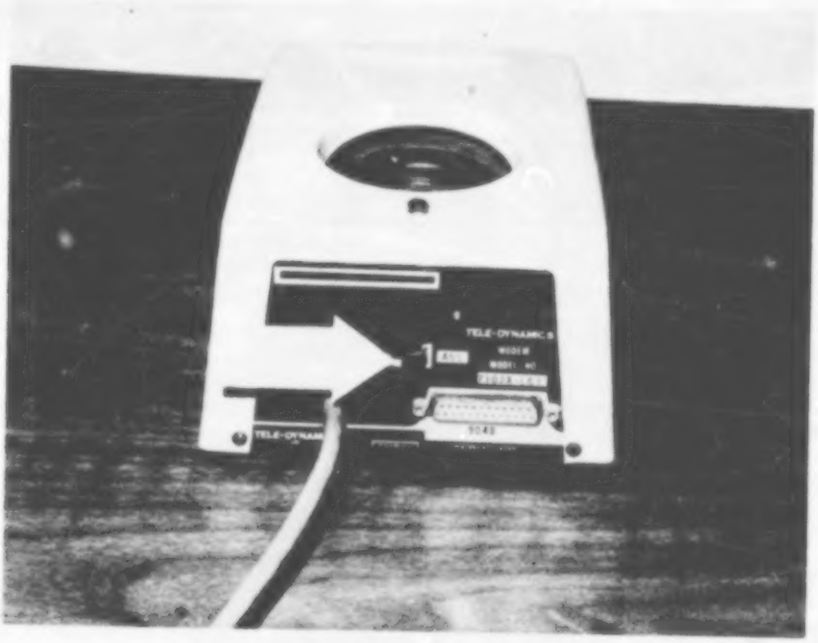

FIGURE 9

She might then have you push the ANSWER switch (Fig. 9) on the back of the COUPLER. The ANSWER switch on the back of the COUPLER must be pushed to the RIGHT. Pushing the ANS switch to the RIGHT will cause a tone sound to start. The telephone handset is then placed in the coupler as shown. (Fig. 10).

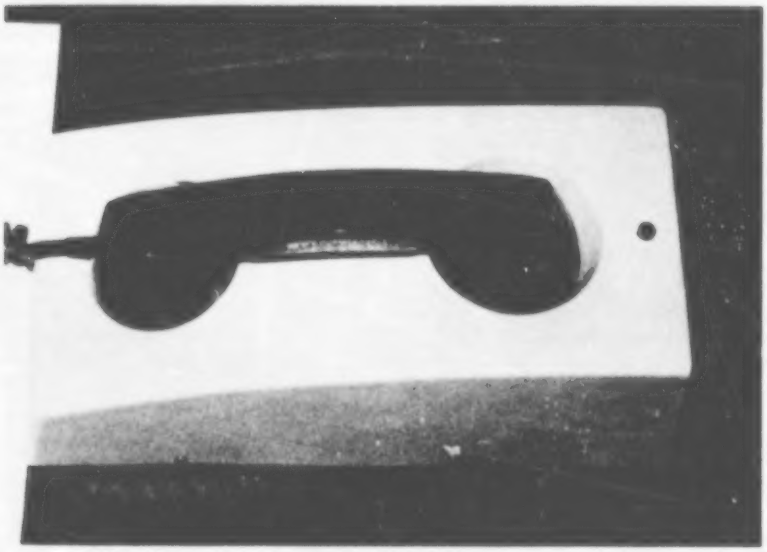

FIGURE 10

It is IMPORTANT to put the telephone handset into the acoustic coupler correctly. (See Fig. 10). The cord goes in the notch on the coupler and the orange light will be closest to the earphone.

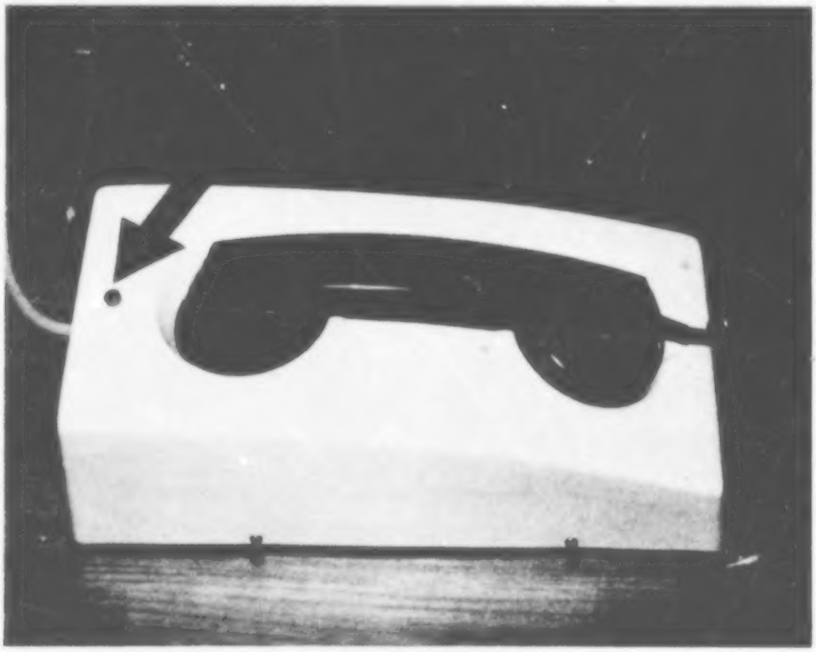

FIGURE 11

The arrow in Figure 11 points to the ORANGE light that will light up when the connection is complete. This could take as long as one (1) minute after the telephone handset is placed in the coupler.

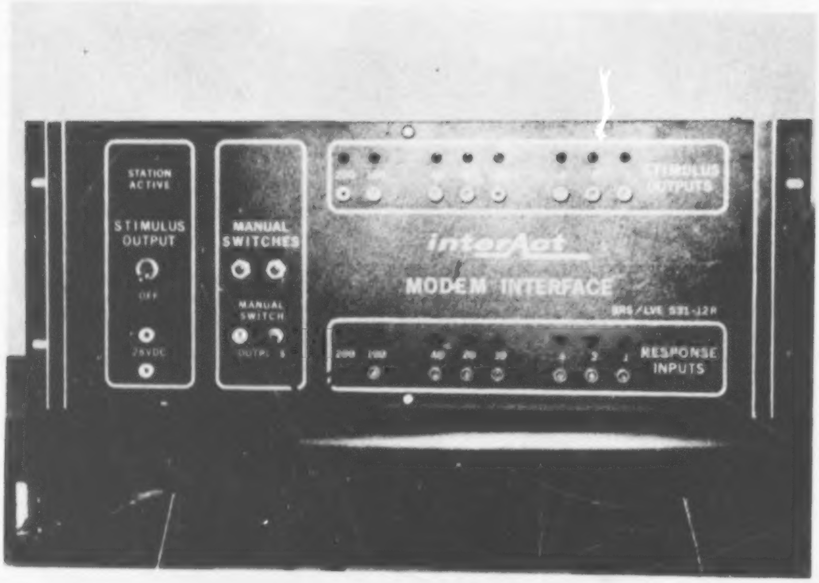
STATION ACTIVE
STIMULUS OUTPUT
OFF
28VDC
MANUAL SWITCHES
MANUAL SWITCH
STIMULUS OUTPUTS
interAct
MODEM INTERFACE
BRS/LVE 531-12R
200 100 40 20 10 4 2 1
RESPONSE INPUTS

FIGURE 12

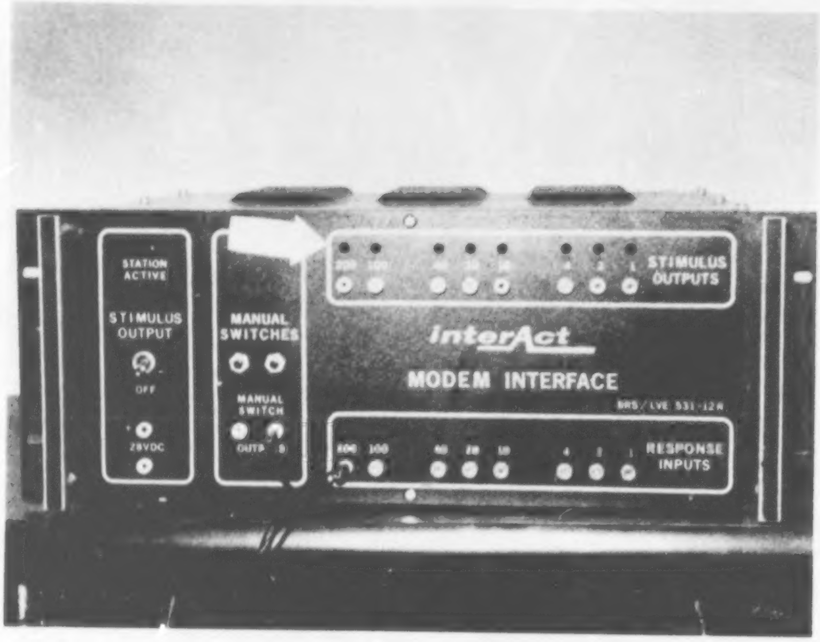
STATION ACTIVE
STIMULUS OUTPUT
OFF
28VDC
MANUAL SWITCHES
MANUAL SWITCH
200 100 40 20 10 4 2 1
STIMULUS OUTPUTS
interAct
MODEM INTERFACE
BRS/LVE 531-12R
200 100 40 20 10 4 2 1
RESPONSE INPUTS

FIGURE 13

About thirty (30) second after the COUPLER LIGHT comes on the STIMULUS OUTPUT light 200 will start to flash on and off. When this occurs, push the MANUAL SWITCH #1 (Fig. 14) ONE TIME when you and your child are ready to work. Pushing the manual switch will start the lesson.

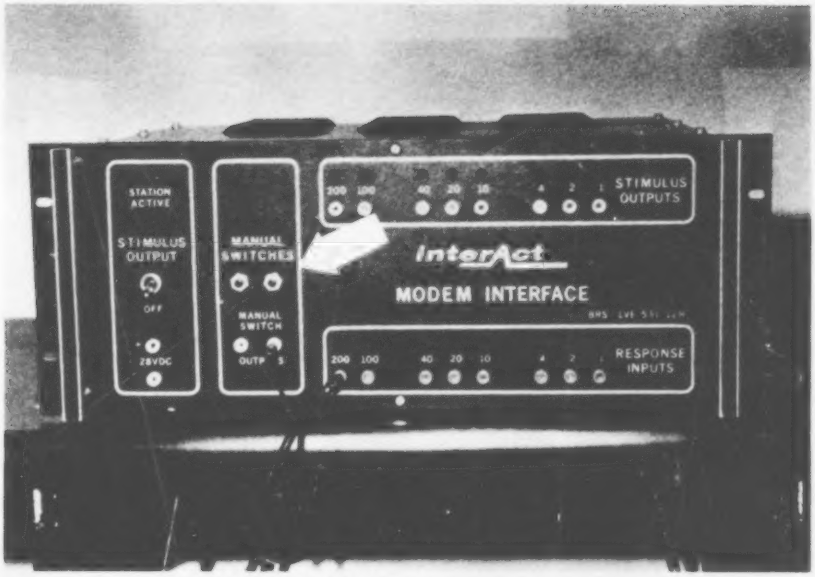
STATION ACTIVE
STIMULUS OUTPUT
OFF
28VDC
MANUAL SWITCHES
MANUAL SWITCH
OUTP S
200 100 40 20 10 4 2 1
STIMULUS OUTPUTS
InterAct
MODEM INTERFACE
200 100 40 20 10 4 2 1
RESPONSE INPUTS

FIGURE 14

SEQUENCE OF OPERATION

1. At ____________ (5 minutes before the scheduled lesson time), turn ON the power supply. (Fig. 8).

2. Check all switches on the acoustic coupler to make sure they are in the OFF (left) position. (Fig. 9).

3. At __________, the operator will call.

4. If the operator tells you to, push the ANS switch on the acoustic coupler to the RIGHT. (Fig. 9).

5. Then put the telephone handset into the acoustic coupler. (Fig. 10).

6. Turn the slide projector ON. (Fig. 15).

7. When the stimulus output lights 100 & 200 on the Modem Interface wink back and forth (Fig. 13), push the MANUAL SWITCH #1 -- ONE time. (Fig. 14).

8. Turn ON the tape recorder. (Fig. 19).

9. Work with your child on the learning apparatus.

10. At the end of the lesson, talk to the operator again.

11. Turn OFF the tape recorder. (Fig. 20).

12. Turn OFF the ANS switch. (Fig. 9).

13. After hanging up the telephone, turn the tray of slides to the ZERO position. (Fig. 17).

14. Turn the slide projector to the FAN position. (Fig. 18).

15. Turn OFF the power supply. (Fig. 8).

16. Three (3) or four (4) minutes later turn the slide projector to the OFF position. (Fig. 18).

TROUBLESHOOTING OR
WHAT WENT WRONG?!

1. Is the interface switch in the ON position? (Fig. 3)

2. Is the power supply switch in the ON position? (Fig. 7)

3. Did the orange light on the coupler come on? (Fig. 11) If not, and the operator is not on the telephone, HANG UP! The operator will call back.

4. Are any of the other switches (besides the answer switch) on the coupler in the ON (right) position? The *ecco* and *copy* switches are *always* to be in the OFF position (left). (Fig. 9).

5. Is the power supply plugged into the wall outlet? (Is the station active light on?)

6. No music from the tape recorder -- does the tape need turning over or rewinding?

7. Music plays all the time -- is the remote plug in the correct position? (Fig. 21).

8. Is the phone handset in the correct position in the coupler? (Fig. 10).

9. Is the wire in manual switch #1 hooked to the response input 200 (bottom row of lights)? (Fig. 14).

SLIDE PROJECTOR OPERATION

The slide projector is located in the back of the windowed box. To turn ON the projector, the switch (Fig. 15) must be moved up to the TOP LAMP position.

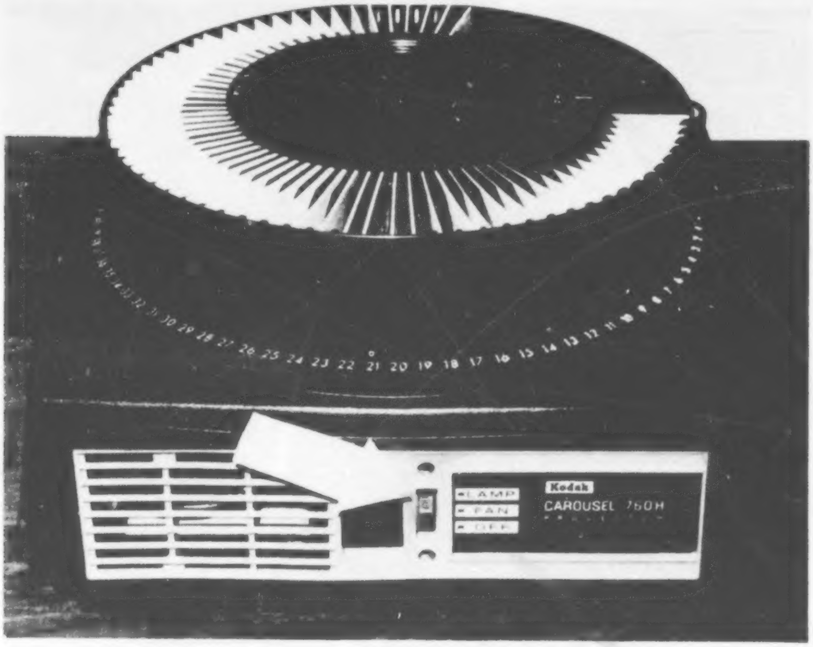
LAMP
FAN
OFF
Kodak
CAROUSEL 760H

FIGURE 15

The slide tray must be in the ZERO (0) position (Fig. 16) at the start of each lesson.

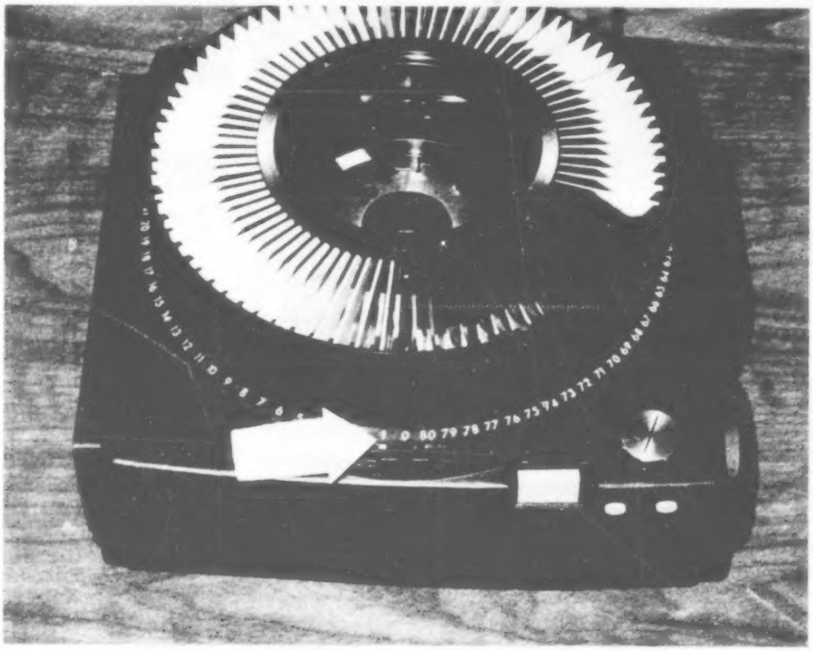

FIGURE 16

Figure 17 shows the lever on the right side of the slide projector that must be held down to move the tray of slides. At the END of each lesson, the slide tray should be put back into the ZERO position.

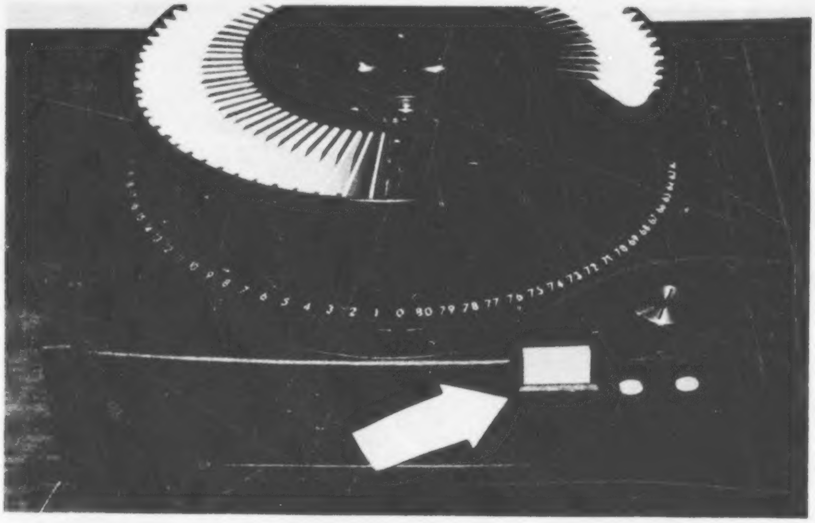

FIGURE 17

Also, at the end of each lesson, the projector must be cooled down before it is turned off. To do this, the switch (Fig. 18) should be moved to the FAN (middle) position. Three (3) or four (4) minutes should be enough time to cool the projector. The switch should then be moved to the OFF (bottom) position.

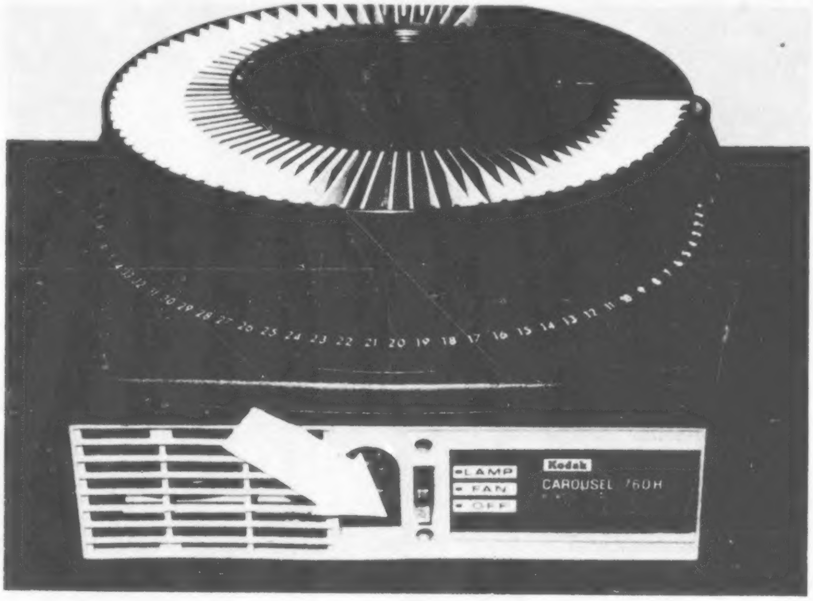

FIGURE 18

TAPE RECORDER OPERATION

The tape recorder should be turned ON just after you push Manual Switch #1. To turn ON the tape recorder (Fig. 19) depress the CUE button (second from the right).

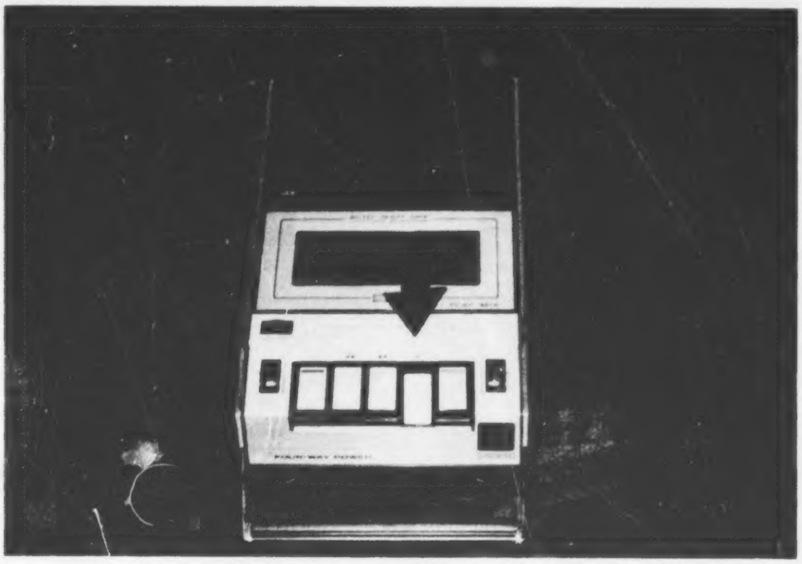

FIGURE 19

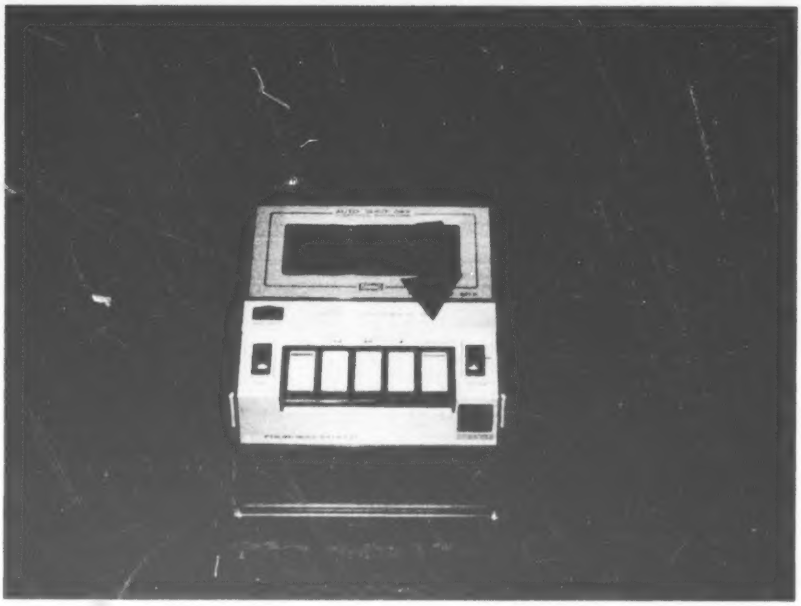

FIGURE 20

To turn OFF the tape recorder (at the end of the lesson) or to turn the tape over, depress the STOP/EJECT button (Fig. 20).

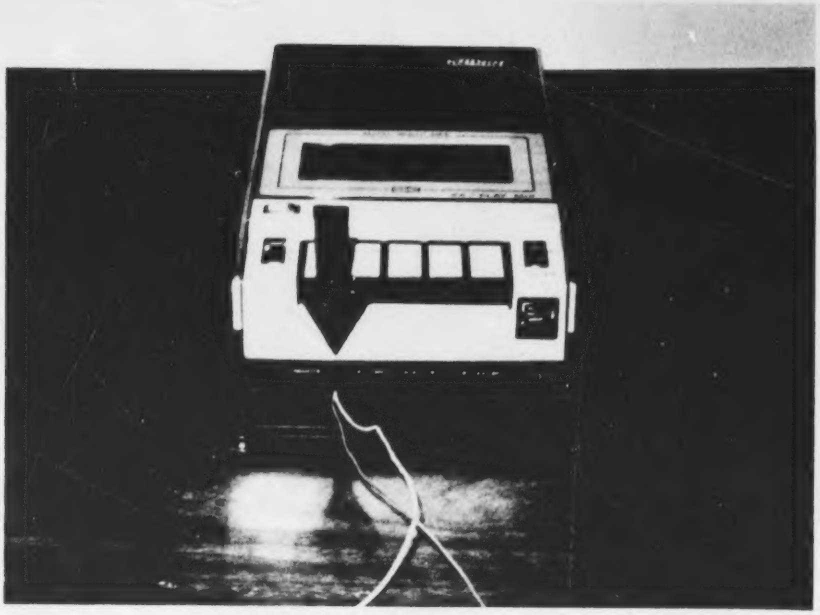

FIGURE 21

Make sure at the start of each lesson that the remote plug is in place (Fig. 21). If the plug is not in place, the tape will play continuously.

APPENDIX D

DISSEMINATION ACTIVITIES

DISSEMINATION ACTIVITIES

A. PRINTED MATERIAL:

1. A chapter "Educating Severely Handicapped Children and Their Parents Through Telecommunications" was written and will appear in: N. Haring and L. Brown (Eds.), Teaching Severely and Profoundly Multihandicapped Children. New York: Grune and Stratton. In press, 1976 (Appendix A)

2. A chapter "Computer Technology, the Perennial Great White Hope for the Handicapped". In Prehm, H.J., and Deitz, S.J. (Eds.) Early Intervention for the Severely Handicapped: Programming and Accountability. Eugene, Oregon: Area of Special Education, University of Oregon, Monograph #2, 1976.

3. A brochure was developed and disseminated to state and local agencies who work with parents and/or severely handicapped infants including Kentucky local school district superintendents and supervisors, Kentucky DDSA directors, state and national college and university personnel, and state directors of special education.

B. CONFERENCE/WORKSHOP PRESENTATIONS:

1. Council for Exceptional Children International Convention, Los Angeles, California, April, 1975.

2. Kentucky State Conference on Programs for Exceptional Children, Louisville, Kentucky, October, 1975.

3. American Association for the Education of the Severely/Profoundly Handicapped Second Annual Conference, Kansas City, November, 1975.

   a. The project director participated, along with the other telecommunications project directors and the BEH project officer, in one session to describe and discuss the five telecommunications projects.

   b. The project director chaired a panel which discussed "Service Delivery to Sparsely Populated Areas".

   c. A third session entitled "Instructional Technology ..." involved the project director. Basic issues related to technology development were addressed and learning devices built on the project were discussed.

4. University of Oregon Severely Handicapped Conference, Eugene, Oregon, February, 1976.

5. New Mexico Federation of Council for Exceptional Children Conference, Santa Fe, New Mexico, March, 1976.

6. Kentucky Federation of Council for Exceptional Children Conference, Lexington, Kentucky, March, 1976.

7. Council for Exceptional Children International Convention, Chicago, Illinois, April, 1976.

8. Churchill Park School, Jefferson County Public Schools, Louisville, Kentucky, April, 1976.

9. Pulaski County Association for Children with Learning Disabilities, Somerset, Kentucky, May, 1976.

C. MEDIA:

1. A slide presentation was developed and has been used extensively at conference/workshop presentations and with visitors to the project site.